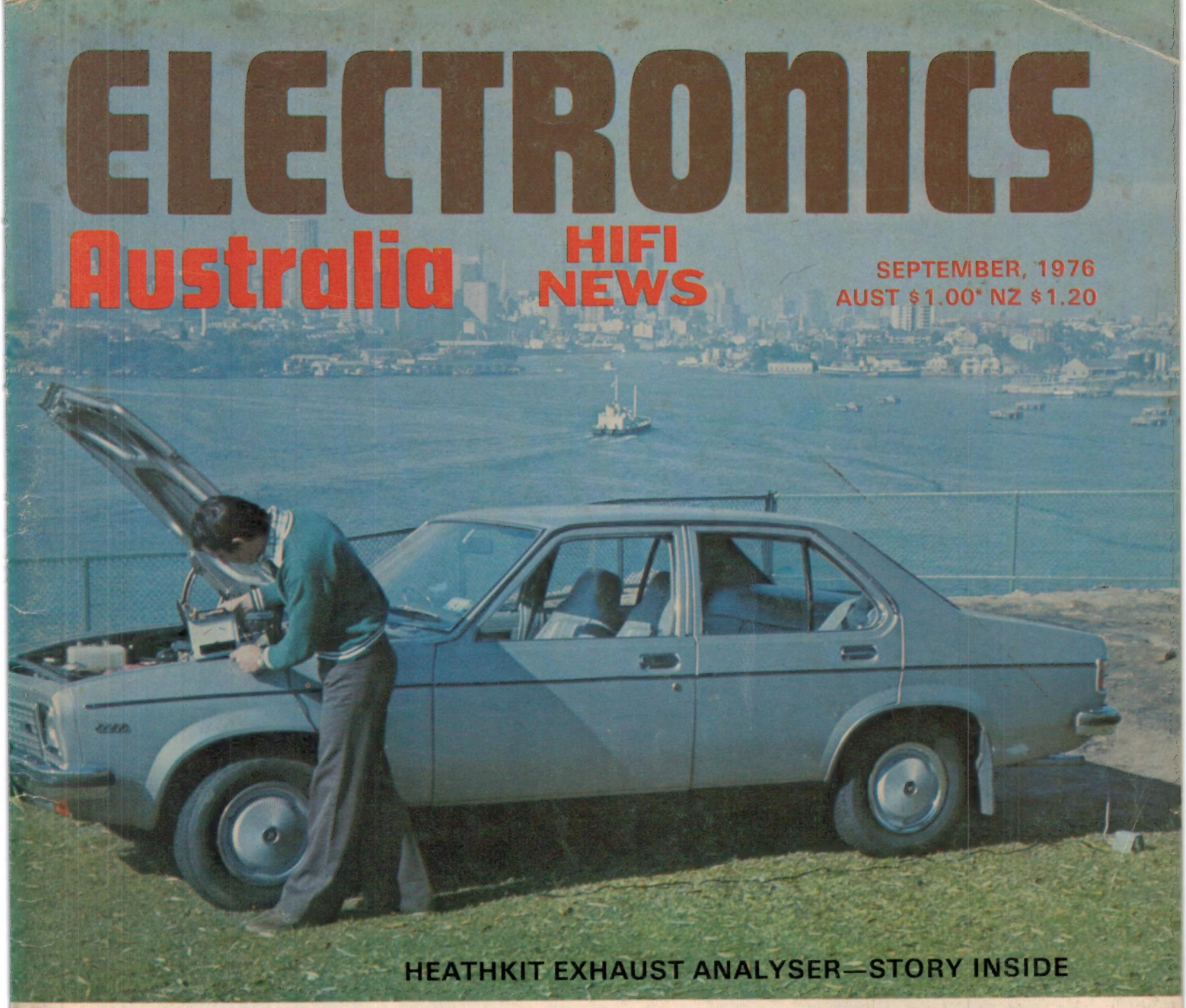
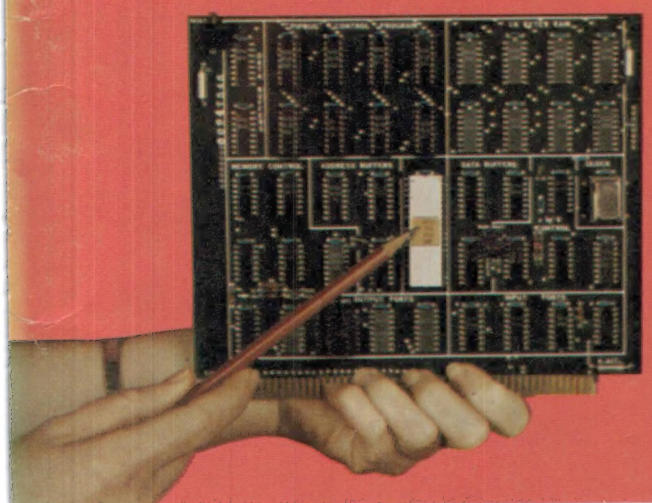
ELECTRONICS Australia

HIFI NEWS

SEPTEMBER, 1976
AUST $1.00* NZ $1.20



HEATHKIT EXHAUST ANALYSER—STORY INSIDE



NEW MUSICOLOUR HAS WIDE-RANGE INPUT *

FULLY SOLID STATE 3.5MHZ TRANSMITTER *

NOVEL BURGLAR ALARM

ABOVE: SIGNETICS MICROPROCESSOR SYSTEM (FEATURED INSIDE)

From Sony research... a totally new turntable system

Sony PS-4750

Superb Fidelity from Today's Most Advanced Direct Drive

Audio experts the world over have been waiting for it . . . Sony's incredible PS 4750, the ultimate turntable system.

State of the art takes on a new meaning with the PS 4750, probably the quietest turntable ever made.

In one elegant design Sony has reduced rumble, feedback wow and flutter to minute levels far beyond hearing and virtually beyond measurement. Wow and flutter for instance is an amazing 0.03% (wrms.) Signal to noise is better than 70 dB (DIN-B).

Sony achieved this in a number of ways:
First, all the belts, pulleys, idler wheels and other paraphernalia used in conventional turntables to make the turntable spin at the record's speed, instead of the motor's, have been eliminated.

The Sony PS 4750 has no need for these troublesome, noisy and fluttering parts, because its slow-revving D.C. motor is directly coupled to the platter.

Speed accuracy takes on new meaning with another Sony breakthrough, the "Magne-disc Servo Control."

Through a unique multi-gap head, this system automatically reads turntable speed through speed detective signals magnet-coated on to the turntable rim. Should there be any deviation induced by fluctuations in power supply, it immediately "instructs" the servo motor to make micro-accurate adjustments.

Another triumph of Sony research is the very material used to make the cabinet and turntable, B.M.C., developed specifically for audio use because its damping and resonance characteristics are 30 per cent better than the conventional aluminium diecast. B.M.C. is also virtually free of expansion or contraction, freeing the design of any problems arising from temperature changes.

Sony innovation didn't stop there. Look at the revolutionary rubber disc supports. These insulation mats are of a unique design which firmly grips the record, effectively insulating the disc from vibration when the turntable revolves. By preventing vibrations, these mats contribute to the stereo effect and significantly improve presence.

The precision tonearm is a universal type which accepts all quality shells and cartridges. Some of the Sony PS 4750's other advanced features are: stylus pressure adjustment (0-3 g), anti-skate compensator, viscous-damped (up and down) arm lifter, see-through stroboscope, independent pitch control (+ 4% on both 33⅓ and 45) and large insulator legs for effective prevention of audio feedback.

If you've been waiting for the ultimate turntable, you need wait no more. The superb Sony direct-drive PS 4750 is here.

SONY®
Research Makes the Difference

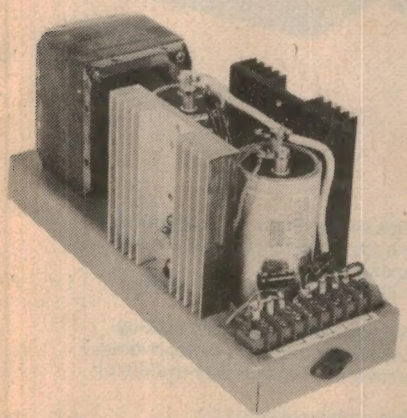
GAC.S.7532

ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 38 No 6

On page 36 this month we describe a completely new Musicolour circuit—the Musicolour III. Driven from the amplifier loudspeaker terminals, it is used to audio-modulate coloured 240V lights to produce an exciting display from your favourite records and tapes.



This simple dual power supply has been designed especially for those who are experimenting with microprocessor systems. It provides for two fixed, regulated voltages of +5V and −12V at currents up to 4A and 1.5A respectively.

On the cover

Taken at Greenwich Point, Sydney, with the city in the backdrop, the main theme on this month's front cover shows the Heathkit Model CI-1080 Exhaust Gas Analyser checking the exhaust emission of a typical family sedan. A full description of the Model CI-1080 commences on page 44. Inset shows the Signetics PC1001 microprocessor evaluation kit, with the pencil pointing to the 2650 microprocessor device. Our article on page 64 has all the details. (Photograph courtesy Philips Industries.)

CONTENTS—SEPTEMBER, 1976

world of electronics and hi-fi

projects and technical

regular features

NEW KIT!

You can build this 12" three-way imported Philips speaker system

— all it takes is a couple of hours and a screwdriver

PHILIPS Electronic Components and Materials

This new addition to the Philips series of assemble-it-yourself professional quality speaker systems introduces an altogether higher standard of performance.
It is a three way system with imported European tweeters, squawkers and woofers.
By assembling the kit yourself you save on a ready built-up system. All you need is a screwdriver, a couple of hours or so, and you will have a magnificent three-way speaker system of professional finish.
The kits are complete. There's nothing else to buy.

The Philips AD 12K12 Speaker kit contains:

2 AD 0140/T8 tweeters
2 AD 5060/5Q8 squawkers
2 AD 1265/W8 woofers
2 ADF 500/4500/8 networks
2 ADF 12K12 level control modules
2 sets of leads with fastons
2 tubes of woodglue
Strip caulk sealing compound
Innerbond damping material
44 wood screws

The Philips AD 12K12 TK kit contains:

2 enclosure kits with walnut grain, wrap around walls, stained baffles and grille cloth assemblies.

Plus full assembly instructions

For further information contact
PHILIPS ELECTRONIC COMPONENTS AND MATERIALS,
P.O. Box 50, Lane Cove. N.S.W. 2066
Or phone 421261 or 420361. Branches in all States.

PHILIPS

153.0159

Editorial Viewpoint

Engineers and technicians are citizens too!

How many times have you heard technical people criticised for not taking enough interest in the social implications of technology? The criticism has been made so many times that technology has become almost a dirty word, and many technical people have become needlessly apologetic and self-effacing.

Yet when we technical people do show concern at the way the fruits of technology are being used, we are very often told quite curtly to mind our own business, and not to meddle in matters which supposedly don't concern us. This can be particularly true if the things we say are contrary to the opinions of those with vested interests.

I well remember getting this sort of response a couple of years ago when I expressed concern in this column about the levels of violence and commercialism in children's television programs. No sooner had the issue in question been published, I received a most indignant letter from the manager of a program packaging company telling me to stick to purely technical matters because I had no right to voice an opinion in a field where I was not a practitioner. Apart from the highly questionable logic, this was in fact false—because as a parent of three children I am indeed a practitioner in the field!

What reminded me of this earlier event was a 'phone call I received the other day from an ABC employee, professing himself to be very shocked and upset about my comments in the July issue on broadcasting administration. I had no right to express opinions on such matters in a technical magazine like EA, I was told, and by doing this I was grossly abusing my "privileged position of power".

It soon became clear that the real reason my caller had become upset was that he had a vested interest. I had suggested that a single authority be set up to administer both broadcasting and non-broadcasting use of the electromagnetic spectrum, and he saw such an authority as a potential "Big Brother" capable of imposing political and other insidious forms of censorship.

As it happens, I do think that this is a potential danger, although I believe it could be prevented by suitably limiting the authority's areas of responsibility.

Of course, the ironic thing about my caller's position is that he was seeking to suppress my opportunity to express opinions in this medium, because he was worried about losing the opportunity to express his own opinions in another medium!

Be that as it may, however, the point I'm trying to make is that when we technical people do express opinions on social implications and uses of technology, we can expect to receive some flak. To a certain extent we can't win, whether we keep silent or speak up.

So if you feel strongly enough, you might as well speak up!

Jamieson Rowe

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The superb Luxor 'Music Centre' with record player, cassette deck, AM/FM radio.

Introducing the Luxor 'Swedish Sound'

Sweden's largest-selling range of high quality stereo systems is here to spread its superb sound around Australia

In 1923 at Motala in Sweden, Luxor first began mass production of radio sets. Today, Luxor are Sweden's largest selling, high quality stereo systems.

Record players of precision and reliability. Luxor features include a magnetic dynamic cartridge with adjustable stylus pressure. And a 16-pole synchronous motor and belt-drive for low wow and flutter.

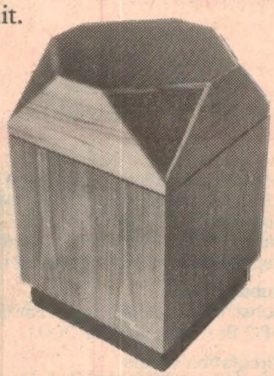
The popular Luxor Record Player

Amplifiers with the quality of 'Ambiophonic sound'. Luxor have developed a 4-channel stereo system, called 'Ambiophonic sound', as a feature of the larger amplifiers. Other features include easily-operated slide controls, and switches for automatic frequency control, AM/FM radio, tape recorder, record player, headphones and loudness compensation.

Cassette decks for fast, smooth operation. With a Dynamic Noise Limiter or Dolby noise suppression. Automatic switching for chrome dioxide tapes. And, 90 second fast-forward and rewind on C-60 tapes.

The Luxor Cassette with Dolby noise suppression.

Speakers to suit all systems. From the Omni-directional Luxor loudspeaker with a 20 cm bass unit and four 5 cm treble units. To the 15 W speaker with a 13 cm drive unit and 6.5 cm treble unit.



The Omni-directional loudspeaker for floor standing adjacent to wall.

They look as good as they sound. Luxor stereo systems combine a careful attention to detail with an unmistakable touch of design flair. Elegant and sleek. In superb cabinets of walnut, teak and rosewood. And black or white lacquer.

The superb Swedish sound. As Sweden has developed in the world of music, so Luxor has developed in reproducing that sound.

The more you know about Luxor stereo systems, the more impressive they become.

The need for distributors and stockists to spread the sound. Distributors are required in Queensland, South and Western Australia and Tasmania. And stockists are required in all States. See the coupon below.

LUXOR
of Sweden

To: Luxor, P.O. Box 205, Glen Iris, Vic. 3146

I would like to know more about the superb range of Luxor stereo systems.
I am interested in becoming a Luxor Distributor ☐
I am interested in becoming a Luxor Stockist ☐

Name.....

Address.....

.....

.....Postcode.....

LUX139

Top Disc Cutting Studios, like The Mastering Lab, rely on Stanton's 681-Calibration Standard in their Operations.

Not everyone who *plays* records needs the Stanton Calibration Standard cartridge, but everyone who *makes* records does!

At The Mastering Lab, one of the world's leading independent disc mastering facilities, the Stanton 681 Triple-E is the measuring standard which determines whether a "cut" survives or perishes into oblivion.

A recording lathe operator needs the most accurate playback possible, and his constant comparing of lacquer discs to their original source enables him to objectively select the most faithful cartridge. No amount of laboratory testing can reveal true musical accuracy. This accuracy is why the Stanton 681 Series is the choice of leading studios.

When Mike Reese, principal disc cutter at The Mastering Lab, plays back test cuts, he is checking the calibration of the cutting channel, the cutter head, cutting stylus, and the lacquer disc. The most stringent test of all, the evaluation of direct to disc recordings, requires an absolutely reliable playback cartridge . . . the 681 Triple-E.

All Stanton Calibration Standard cartridges are guaranteed to meet specification within exacting limits. Their warranty, an individual calibration test result, comes packed with each unit. For the technological needs of the recording and broadcast industries, and for the fullest enjoyment of home entertainment, you can rely on the professional quality of Stanton products.

STANTON

Sole Australian Distributors:

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VICTORIA Office: 103 Pelham St., Carlton 3053. Phone 347 7620.
Available at quality conscious Hi-Fi dealers throughout Australia!

LER 146

SC-2002

The True Hi-Fi Front-Loading Cassette Deck. It makes sense.

A well-made cassette tape deck these days gives open reel a good run for the money.

If you're involved with music at the true hi-fi level, here's a reliable one from Sansui. Note:

Front-loading convenience means positioning your tapes right-side up and keeping them vertical and fully visible at all times. Important? You'll discover front-loading saves a lot of tape trouble.

The electronic DC servomotor gives constant speed regulation regardless of voltage changes or tape loads. Independent capstan drive contributes to very low wow/flutter (0.1%). Fully automatic stop and shut-off is even more operating convenience.

The SC-2002 makes sense in other ways, too. Dolby noise reduction ensures recordings made from any source will playback with a drastically reduced tape hiss and noise content.

And such features as output level control, left/right independent recording level controls and wide dynamic range mic circuits contribute to fine sound performance.

The SC-2002 is one of four fine Sansui front-loading decks now available in different styles and price ranges.

When you come right down to it, our true hi-fi components sound so good because hi-fi is the only thing we make.

Maybe this is why we always make sense to people who love music.

Sansui True Hi-Fi

Sansui

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George Tillett reports on:

THE CHICAGO CONSUMER ELECTRONICS SHOW

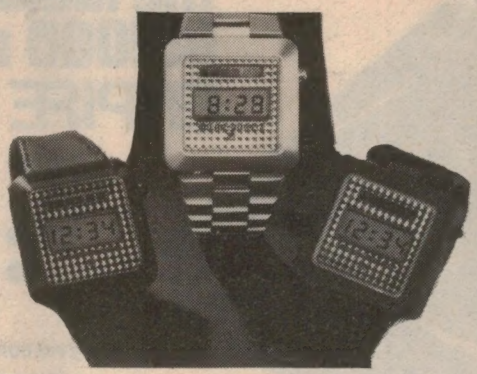
There were a record number of exhibitors at this year's Consumer Electronics Show, which was held as usual in Chicago's huge exhibition center at McCormick Place. One official calculated that a visitor would have travelled a distance of more than 3½ miles if he saw every stand and display —650 of them!

Mercury's new 15-function "Masterchron" LED chronograph combines the functions of a finely styled watch with a multi-function stopwatch, with increments of 0.1 and .01 second. It can freeze and display lap times, etc., without affecting its count of total lapsed time for the event. Available in stainless steel or gold plate, it has scratch resistant face and is water resistant. Retail price in America should be under $100. (Mercury Time Division of Liesurecraft Products Ltd.)

For a show visitor, 3½ miles plus standing time can be quite a hike but, if he took in all the 100 or so "extra-mural" demonstrations at hotels all over the town, he would have travelled something like 10 miles according to my calculations!

Emphasis this year was on CB radio, video games, calculators and high-end audio equipment. Digital watches were well in evidence, too, but manufacturers (already worried by calculator prices slidng down to $6.95) were disturbed by news of a $19.95 digital watch.

The tremendous CB radio boom shows no sign of coming to an end and industry experts are happily forecasting 15 million total sales by next year! As you might expect, the 27MHz band is rather crowded and the FCC is considering proposals to add more channels to the 23 now in use. This will obviously be a short term solution and manufacturers are pressing for space in the 220-225MHz band. The 900MHz band has also been suggested but a EIA committee has turned this proposal down, saying that the range is limited and equipment is too expensive at present.



Developed in the Federal Republic of Germany, this "Cristalonic Computer GmbH" watch is being described as a "sun dial on your wrist". Reacting to sunlight, or even ordinary room brightness, solar cells can keep the internal "energy accumulator" topped up, with a "back-up" time of 1 year. (Cristalonic Computer GmbH, P.O. Box 269, D-8012 Ottobrunn/Munchen.)

At one of the CES seminars, a top FCC official was asked "shouldn't the government stop housewives and others cluttering up the airwaves with idle chatter?" He replied that it was not the job of the government to censor communications and, as for idle chatter, many TV programs could be considered trivial anyway...

The average CB transceiver would have a rotary switch for the 23 channels, a variable squelch control, combined volume and on/off control and a signal strength meter which doubles as a modulation indicator. The price would be between $90 and $135 and for another $50 it would have refinements like a switchable noise limiter and a fine tuning control. Maximum RF power output is restricted to 5 watts but for about $350 or even less, SSB models can be bought which effectively increase the radiated power to around 12 watts.

Base stations vary from simple units to elaborate and expensive rigs with digital readout, compressor circuts, built-in SWR meters and so on. Rotary beams are quite common and mobile antennas are usually one-eighth or one-sixteenth wavelength with loading coils.

A quick look at the CB displays at the show confirmed the news that more than one company will release transceivers with automatic scanning later this year. One model will offer a choice of three modes, the first stopping at all channels for three seconds and the second stopping at the first "busy" channel; in the third mode, the scan will stop at the first

Manufactured by the Pearce-Simpson Division of the Gladding Corp, this "Simba" CB transceiver offers instant selection of 23 channels, with the facility to operate on AM, or SSB with either upper or lower sideband. It offers all normal control facilities plus metering of transmit and receive functions and aerial loading. The left-hand side of the panel is occupied with a digital alarm clock, which can be set to control the off-on functions of the transceiver.

C.E.C. has a turntable to turn YOU on...

BD1000

the ideal system starter BD1000 complete with EMPIRE 2000E cartridge

- Wow and flutter less than 0.12%.
- Rumble better than 40DB.
- Complete in fully imported base and cover.

Frequency response 10HZ to 30KHZ tracking 1 to 3GM.

BD7000

for the audiophile BD 7000

- DC Hall motor—Servo controlled.
- Built-in strobe light.
- Fine speed adjustment.
- Auto *or* manual operation.
- Wow and flutter less than .04% (WRMS).
- Signal to noise ratio 65DB (DINB).
- Tracking weight 0.25 to 3GM.
- J-shaped tone arm with hydraulic cueing.
- Magnificent, fully imported base and cover.

The BD7000 is supplied without cartridge.

The CEC turntable range includes the semi-automatic BA300 and fully automatic BA600. One of the four models is right for you. All have the famous C.E.C. 5-YEAR WARRANTY.

FIVE YEARS 5 GUARANTEE

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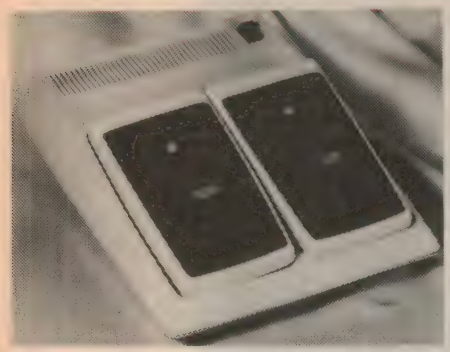


This new CMI/Bowmar video game has two remote controls, each with 12ft of cable, provides a discrete colour display, a choice of 4 games and selectable speed, serve, angle, and paddle size. A 4-player option will be offered, also a cheaper monochrome version. (Continental Microsystems Inc, Box 9518/11347 Vanowen, Nth Hollywood, CA 91609.)

clear channel. One model will have full SSB facilities with sideband indication and digital readout. I also noticed a definite trend towards putting all the controls on the microphone unit—a very logical move.

In the area of television, Advent were demonstrating their two projection systems, one with a 6 ft (diagonal) screen. Three other companies were showing large screen projection systems with prices running from $1500 up to $3000.

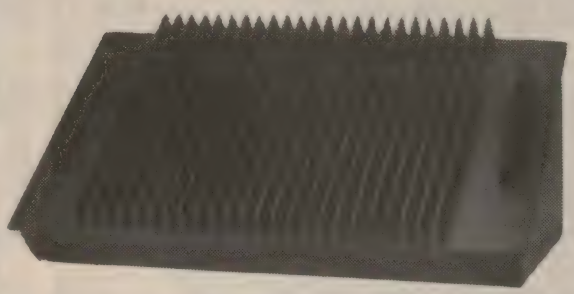
But the big interest was in video games and no less than 30 manufacturers were represented. Some of these games were complete, others used the domestic TV, feeding the signal to the antenna connections.

A typical unit, the Federal, offers a choice of five games: hockey, tennis, squash, electronic target and practice —complete with sound effects—to retail at less than $70! More elaborate units used colors and had provision for four or more players with digital scoring and so on. In a way, I suppose this new development reflects the poor quality of our TV programs...

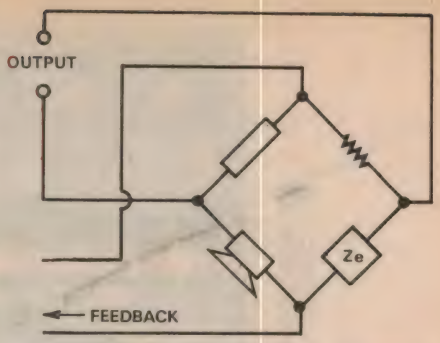
As far as audio is concerned, new products were pretty well distributed from "budget" items to super expensive equipment.

For example, Sherwood have new receivers in the $250 price bracket and they have also released what is called "the world's first and only FM tuner/computer". This is model Micro 100 FM/CPU and it uses a newly developed microprocessor in a computer circuit. There is a choice of three tuning methods: manual flywheel electronic (no dial cords), auto-scan left and right with electronic touch switches, and four station memory recall, also selected by electronic touch switches. The tuner will display the station's call letters and frequency. There are no external punch cards and programming is said to be very simple. The price of this engineering marvel is about $2000 so most of us will have to turn our tuning controls by hand for some time yet!

Nakamichi were demonstrating an unusual power amplifier, the 620 which has only two high power output transistors instead of multiple parallel devices commonly used. No biasing diodes are employed and distortion at 100 watts per channel is 0.005%. Very little feedback is used and open-loop distortion is said to be less than 0.1%, which is incredible! Styling is also unusual as the heatsinks are mounted on the front with LED power indicators actually built into the fins.



Nakamichi's new model 620 power amplifier uses two high-power devices in the output stage to deliver 100W per channel with a distortion content of about .005%.



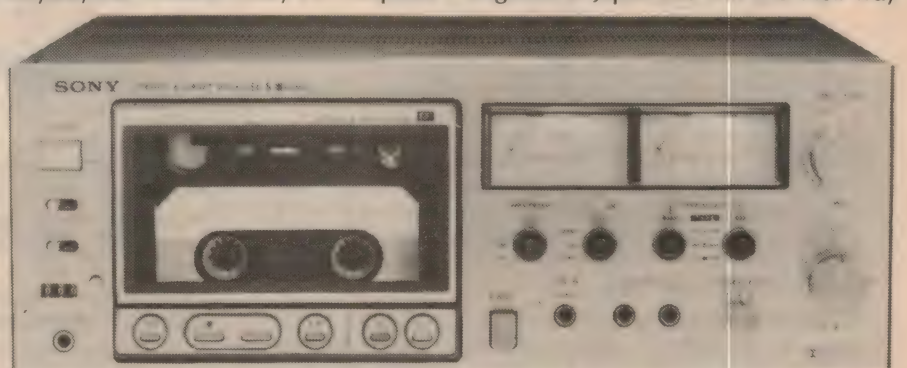
A new French-designed speaker system, the Acoustique 3A series, employs a bridge arrangement to isolate the back EMF for purposes of motional feedback. (See text.)

ESS were showing an unconventional preamplifier in the Eclipse series: it has a completely clean front panel—no knobs, no dials, no levers—just a flush mounted row of electronic touch buttons. There are two for level control, one for up, one for down, with the latter having a faster action. Very neat, but that's not the whole story: supposing an FM tuner is in circuit and the pick up lowered on the record. Would nothing happen or would you get two mixed up programs? What happens is that the FM signal would be switched off automatically, to reappear at the end of the record ...

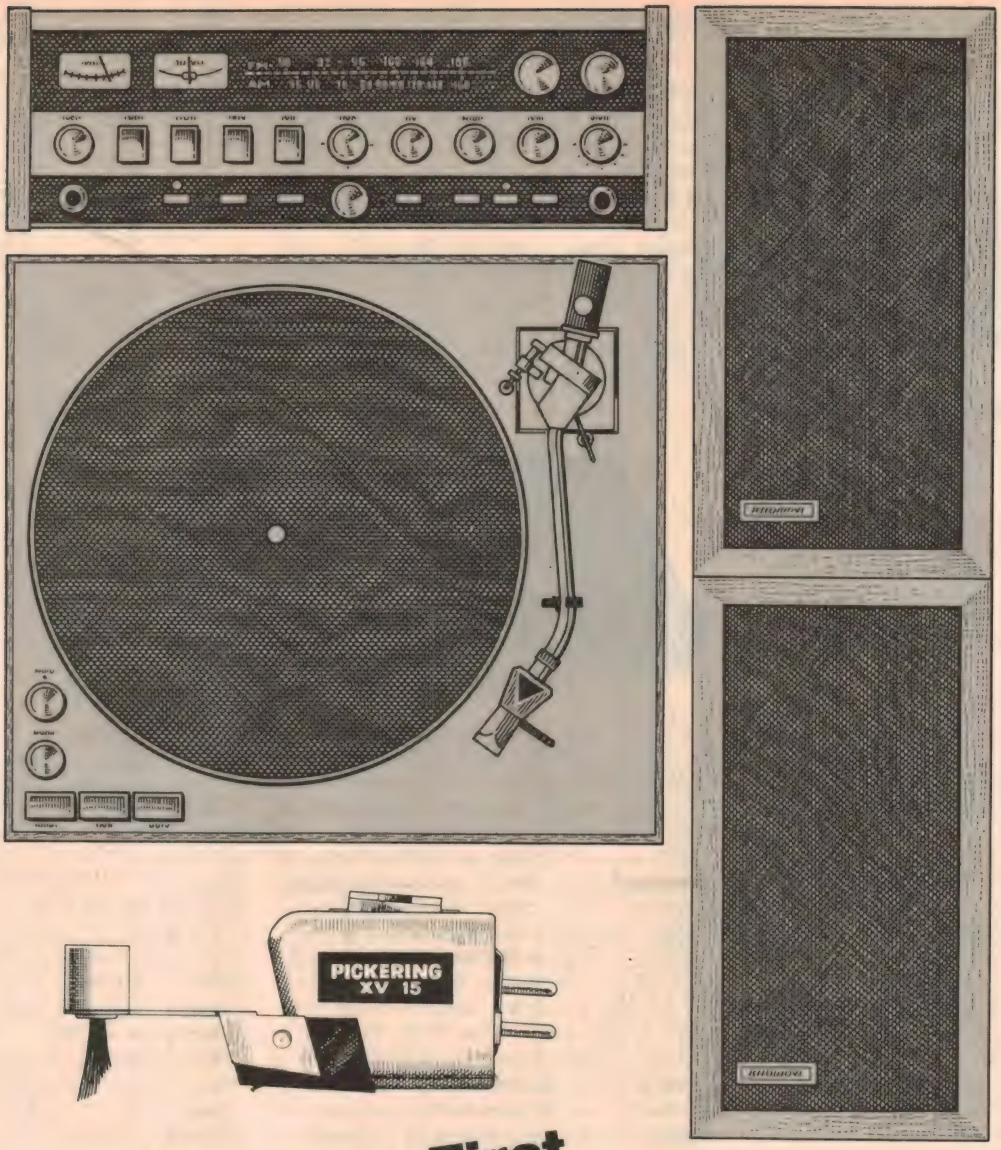
Mention of automation naturally brings me to the ADC Accutrac 4000 computer turntable described as "It's father was a computer, it's mother a turntable" or maybe it's the other way round. Anyway the Accutrac really is a computer controlled turntable. It comes complete with a remote command hand-held transmitter styled something like a calculator. Using this, or the push-buttons on the player, it is possible to program any band or bands on the record in any sequence, or repeat any section—and much more. Thus you could play bands 1, 2, 5 and 7, repeat band 1 or whatever, while sitting in your chair. Built into the phono cartridge is a tiny infra-red generator which senses the unrecorded surfaces on the disc.

After making a program selection, the "instructions" are carried out even after a phone call or sudden thirst makes it necessary to switch on a pause control. If you want to change your selection, all you have to do is press a reject button. Motor is a servo-controlled, direct drive type and the phono cartridge is a modified ADC XLM. The unit is made by ADC's parent company, BSR in England.

There were a great number of new tape recorders on show. Most of them originate in Japan and will find their way



Sony's stereo Elcaset deck model EL-5, the cheaper of two such decks exhibited at the CES. Even so, it has all the facilities that one expects to find on existing compact cassette decks. The more expensive Sony EL-7 has separate reel motors and a variety of other refinements which push it up into the exotic class, retailing at about $850 in the U.S.



Discover The ~~Fourth~~ First Component!

What is your First component? Is it your receiver? Your turntable? Your speakers? Or is it your phono cartridge?

We have become convinced that it really is your phono cartridge, even though we have been modestly advertising it for the past few years as your *Fourth*.

Let's face it, the cartridge *is* that important *first* point where the music begins, and if the stylus cannot follow its path accurately, no amount of expensive equipment . . . speakers, turntable or receiver . . . can make up the distortion it can produce. That is why you need a cartridge you can depend on. One that's the best your money can buy. Specifically, a Pickering:

Because a Pickering cartridge has the superior ability to "move in the groove", from side to side and up and down, without shattering the sound of your music on your records.

Because a Pickering cartridge possesses low frequency tracking ability and high frequency tracing ability (which Pickering calls *traceAbility* ™). It picks up the highest highs and the lowest lows of musical tones to reveal the distinctive quality of each instrument.

Because Pickering offers a broad range of cartridges to meet any application whether you have an automatic record changer, or a high quality manual turntable, a stereo, or a 4-channel sound system. Your Hi-Fi dealer will be able to recommend a Pickering cartridge that is just right for *your* system.

Your stereo cartridge is the *First* part of your music system. It is too important to overlook, and so is a Pickering.

For further information, see reader service card or write to Pickering & Co., Inc. Dept. P, 101 Sunnyside Blvd., Plainview, N.Y. 11803

PICKERING
"for those who can hear the difference"

For further information write to—Fred A. Falk & Co. Pty. Ltd., P.O. Box 34, Rockdale, N.S.W. 2216, Australia. Tel. 597 1111 • Fountain Marketing Limited, P.O. Box 5029, Auckland, New Zealand. Phone 76 3064.

to Australia sooner or later—most likely before they reach this side of the Pacific!

The really important news was the unveiling of the "Elcaset" a 3¾ ips cassette using quarter-inch tape. It was developed by a consortium: Sony, Matsushita and TEAC and there is no doubt of its long range impact. The cassette size is 2½ times the conventional 1⅞" unit and frequency range, distortion and signal-to-noise will be superior. Not only that, but wow and flutter should be less as the tape transport is much less dependent on the mechanics of the cassette itself.

Sony were showing two recorders designed for Elcasets: models EL-5 and EL-7, the latter using a DC servo motor with two reel motors, logic controls, Dolby system and provision for FeCr tapes. Price is expected to be about $850. The EL-5 has only one motor and lacks some of the refinements such as a built-in 400Hz calibrator but the price will be about $200 less.

Another interesting and even more expensive cassette deck was introduced by TEAC. This is the well-named Esoteric 860 which is the "first deck to have a built-in DBX noise reduction system." The specifications are most impressive: more than 30dB of noise reduction over the audio range, an expanded dynamic range up to 85dB and a gain in headroom of 10dB! There are three motors, including a DC servo type and the wow and flutter is claimed to be less than 0.04%. Among the features is a four in, two out mixer, three heads with signal-source monitoring, full logic control, tape inching facility and a variable speed control. And there is a built-in Dolby system too!

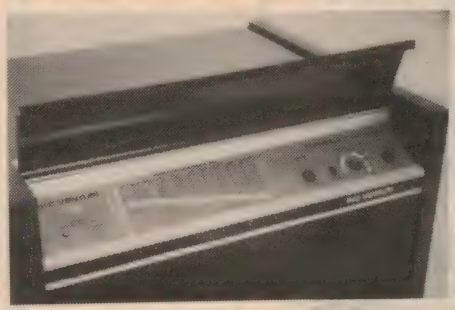
TECA's "Esoteric" tape recorder/players put the emphasis on facilities and performance, even if it means paying a higher price, as noted in the text above. Illustrated on the left is the TEAC "Esoteric" series PC-10, obviously intended for the enthusiast who wants a high quality portable.

You might ask why are there two noise reduction systems—surely that's extravagant even for an Esoteric deck? The answer is simple: a Dolby system is needed to play Dolby tapes and record Dolby FM transmissions, as a number of broadcast stations use Dolby encoders here.

Before leaving the subject of cassettes, I ought to mention the IM Suppressor used by Nakamichi in their model 600 deck. It is not a peak limiter but a dynamic non-linear circuit that cancels much of the distortion caused by tape saturation. It functions on playback only and effectively increases "headroom". Obviously, it cannot correct gross distortion but it is really surprising what it can do.

There was a great variety of loudspeakers at the Show using known (and some unknown) acoustical principles.

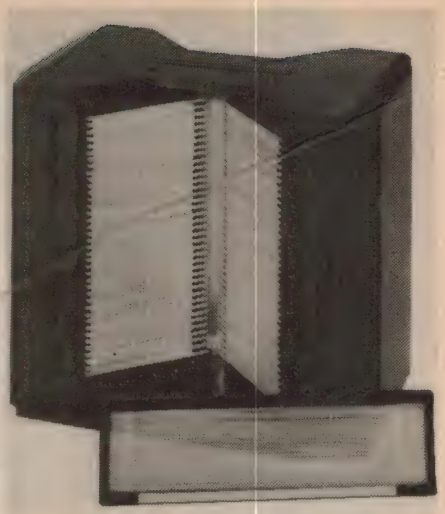
One of the most interesting was the Infinity line source column which stands 65 inches high. The bass speaker is a special 12-inch model using the Watkins patent twin voice coil system, crossing over to a 4 inch cone unit at 200Hz. Mid-range frequencies are handled by 6 dome speakers in a vertical array and high frequencies are fed to a stack of 8 planar units called EMIT's. These transducers are similar to the old French "Orthophase"speakers which used a flat spiral voice coil bonded to a thin plastic diaphragm mounted between bar mag-



B.I.C. Venturi's new Formula 5 and Formula 7 loudspeaker systems set a new fashion in user controls. Placed under a piano style lid, they indicate and protect against speaker overload, compare operating power level with "normal" for a given room volume, provide "Dynamic Tonal Balance" and provision for mid-range/treble level control.

nets.

Several other manufacturers were using similar units in their new models including Acoustique 3A, a French company showing for the first time. Three of their systems use motional feedback (MFB) for the bass speakers and the associated amplifiers are housed in the enclosures. Instead of employing a pickup transducer or twin voice coils, the 3A series use a bridge arrangement to separate the back EMF from the applied signal. At resonant frequencies, the speaker voice coil movement will be greater than the applied signal so an error voltage will be generated. One leg of the bridge is made equal to the characteristics of the loudspeaker in a blocked state and the resultant error voltage (or current) is used as servo feedback. A feature of the 3A demonstration was a six foot thermometer type array of neon power indicators to show the sceptical just how much power is needed to avoid peak clipping. When I looked in, a recording of "Aida" was playing at an average level of below 10 watts but peaks up to 200 watts were quite frequent.



The ESS Heil "air motion transformer" loudspeaker is designed to cover the range 800Hz to 24kHz. Featuring a lightweight Teflon diaphragm, it has a 120-degree dispersion at 20kHz. Square wave rise time is quoted as 15 microseconds at 5000Hz. Magnet efficiency has been increased over earlier models. Next step is to produce a full-range model which would logically compete with full-range electrostatics.

Two full range electrostatic speaker systems were being demonstrated outside the Show. One was the Dayton Wright model which uses an inert gas to improve efficiency and the other was a newcomer—the Acoustat. This also has a built-in amplifier, a hybird transistor-tube unit directly coupled to the plates. The system stands 48 inches high, and is 28 inches wide by 19 inches deep at the base. A feature of the Acoustat is the use of equalisation circuits to compensate for wall reflections at 300 and 600Hz. I should mention that the unit is a dipole, i.e. radiation is "figure of eight". Overall sound was notable for clarity and the low end response was clean, with excellent definition.

B.I.C. used to import Wharfedale speakers but, for the past two years, they have made their own using the so-called Venturi reflex principle. This year they introduced two new models—the Formula 5 and 7. Both use piezo-electric HF units mounted on T-slot horns but whereas the 5 has a 10-inch bass speaker,

(Continued page 17)

Roll over, chromium!

Extracts from an address by Mr. E. Nakamichi, President Nakamichi Research Inc. at a recent Seminar in Sydney for Nakamichi dealers.

"TDK Super Avilyn Cassettes are recommended for use with all Nakamichi tape decks. Before leaving our factory, all Nakamichi equipment has bias voltages set for TDK SA to achieve optimum performance".

"Chromium Dioxide tape is not recommended for use with any Nakamichi tape decks."

"The wear on recording heads is significantly reduced by using TDK Super Avilyn as compared with any Chromium Dioxide tape."

From the report by Louis A. Challis & Associates Pty Ltd. Consulting Acoustical & Vibration Engineers, NATA laboratory.

"TDK Super Avilyn Tape looks like being one of the most important advances in tape formulations in the mid-seventies"

TDK SA breakthrough in tape technology

Super Avilyn's performance exceeds that of Chromium Dioxide formulation which previously was the best choice for linear high frequency response and high-end S/N, but Cr02 suffered from reduced output in the middle and low frequencies (SA provides 1.5-2db more output than the best Cr02 in those ranges, equal output at high frequency).

SA also outperforms the ferric oxide tapes (regular or cobalt energized) which are unable to take full advantage of the noise reduction benefits of the Cr02 equalization because their high end saturation characteristics are not compatible with this standard (they require 1EC 120ms, normal or high EQ).

The net result of SA's characterists and this EQ difference is a tape with an impressive 4-5db S/N gain over the latest top-ranked high output ferric oxide tapes and more than 10-12 db S/N gain over many so-called low noise ferric oxide tapes.

Ask for TDK SA Cassettes.

TDK

Australian Distributor
Convoy International Pty. Ltd.
4 Dowling Street,
Woolloomooloo 2011 358 2088

TV promotion for National / Technics

Those who watched the Olympic Games programs on television—and who didn't—could scarcely have failed to notice the many advertisements for National appliances and for Technics hifi equipment. There's a story behind the advertisements which we happen to know about, because we featured in a couple of them!

by NEVILLE WILLIAMS

It is self-evident that some of the advertisements one sees on television have involved the producers in a tremendous amount of trouble. One can't get beautifully lit pictures of horses streaming across the countryside, without making it all happen at the right time, in the right place. And action pictures involving cars, boats and aeroplanes carry their own evidence of resource and dedication on the part of the camera crews.

But studio shots would seem to be a different matter. A few dozen bits of gear arranged on the floor or what-have-you, a few props and lights, and some canned music. Someone comes on and says their piece, the camera pans over the equipment, and it's all over. Nothing to it!

That's the way it looks on the screen, but out in front of the cameras it's a very different story. That 60-second "nothing to it" commercial may occupy most of the day for a big studio and upwards of twenty people. But more of that later.

The particular series of advertisements had their genesis back in March, this year, when Haco Distributing Agencies Pty Ltd, Australian agents for National and Technics products had the opportunity of co-sponsoring coverage of the Montreal Olympic Games on Australian commercial television. It would cost a lot of money, involve a tremendous amount of preparation but – hopefully – win a lot of product support.

About that time, Haco Marketing Manager Peter Lee was in Japan discussing the possibility of boosting the fortunes, in Australia, of "Technics", the brand name reserved by National/Matsushita for its top of the line high fidelity equipment. From being a market leader in Japan, Technics have had a much smaller proportion of the market in Australia, although enjoying a reputation for very high quality.

In planning a possible nation-wide TV campaign, Haco's Advertising Agency (Quinlan, Mitchell, Malanot & Stott) conducted a survey and found that, while the National brand name was very well known, "Technics" was familiar only to people within the industry and, of course, to those who were readers of hifi and technical journals. Clearly the awareness of the brand name had to be increased and what better way than to let it be seen as a connoisseur extension of the well known National/Matsushita range?

And that's where the focus of the planned campaign settled: National radios, cassette players, etc, for the casual buyers; National appliances, white goods, record players and colour TV sets for home makers; Technics record and cassette players, amplifiers, tuners and loudspeakers for the hifi connoisseur.

And to boost the Technics quality image—gold-plated records and the slogan "Looks a million; Sounds a million".

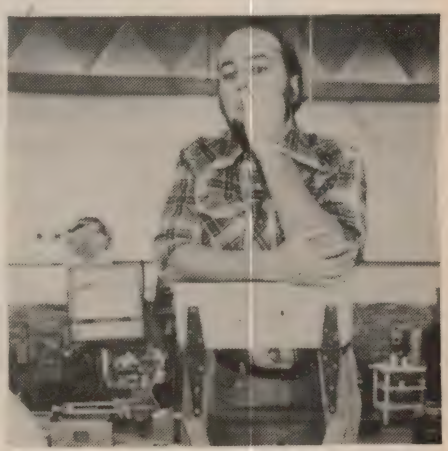
What was needed was a television presentation that would be at the other end of the spectrum from teenagers and dancing girls; something that would communicate the solid technical reputation of Technics hifi equipment to the viewing public. That was where we came in—the editors of various hifi and technical journals.

I can't speak for the other editors but, faced with a request for cooperation, my own reaction was cautious: there could be no argument that Technics hifi equipment was of commendably high quality, and worthy of consideration by a connoisseur/buyer. To offer a partisan recommendation would have been quite a different matter, but this was neither called for nor expected. Our role was purely to authenticate the name.

Facing the production of the actual series of National/Technics series of TV commercials, the Agency hired one of Artransa Park's big studios in Epping NSW, together with the services of Tele-

Production Manager Peter Willese (left) and Director Peter Cellier (right) discuss narration with TV personality Barry Freedman. In the foreground: the Technics logo on a gold "Looks a million" disc.

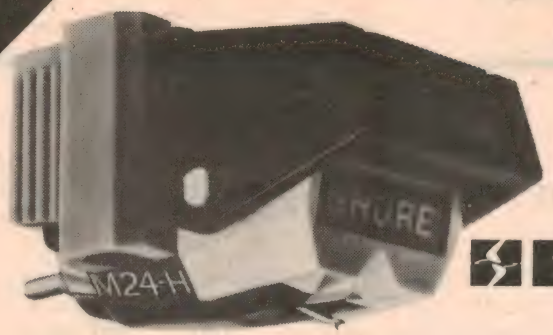
Cameraman David Gribble (right) takes one of a countless number of light readings prior to shooting the final scene. Black speaker boxes posed a special problem, as did reflections from shiny surfaces.



From the top of a step ladder, Advertising Manager Geoff Dawes takes a cameraman's view of the set. Geoff's problem: make sure that the production crew doesn't inadvertantly hide a product that he wants the audience to notice!

2+4!!

UNCOMPROMISED STEREO & QUAD



... UNDENIABLY SHURE®

We call it "2+4": *a totally different concept in a phono cartridge* that combines Shure's traditional pre-eminence in *stereo* and state-of-the-art *quad* technology. It's the first such cartridge that doesn't sacrifice stereo for quad capability!

For quad enthusiasts, both matrix and discrete, this M24H Cartridge represents the distillation of the most advanced quadriphonic technology — PLUS new Shure advancements, such as the lowest effective stylus mass (0.39 mg.) available in quadriphony, and a new hyperbolic stylus tip for improved groove contact.

Each of these dimensions in hi-fi performance would be a best seller in its own right, but with "2+4" synergism, the M24H will be the blockbuster the hi-fi enthusiast has been waiting for.

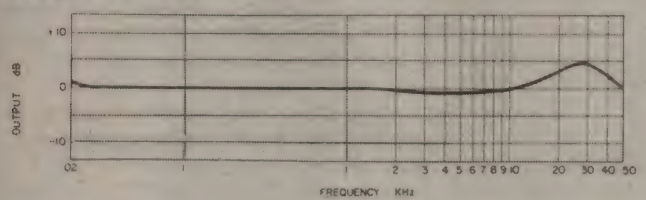
The M24H does not compete with the V-15 Type III or M95 Cartridge. The M24H is for those who want excellent stereo and quad without having to change cartridges every time they change records.

FEW CARTRIDGES AVAILABLE TODAY CAN OFFER THIS COMBINATION OF STEREO SUPERIORITY AND QUAD CAPABILITY.

WIDE-RANGE DYNETIC® PHONOGRAPH CARTRIDGE

BRIEF SPECIFICATIONS

Frequency Response 20 to 50,000 Hz.



Output Voltage 3.0 mV per channel (at 1,000 Hz, 5 cm/sec peak recorded velocity).

Channel Balance Within 2 dB.

Channel Separation (minimum) 22 dB at 1 kHz.

Optimum Load Stereo and Four Channel Matrix: 20,000 to 100,000 ohms resistance in parallel with 100 to 250 picofarads total capacitance* per channel.
Discrete Four-Channel: 100,000 ohms resistance in parallel with 100 picofarads total capacitance* per channel.

* Total capacitance includes the capacitances of the tone arm wiring, phono cables, and the amplifier input circuit.

Tracking Force Optimum: 1¼ grams.

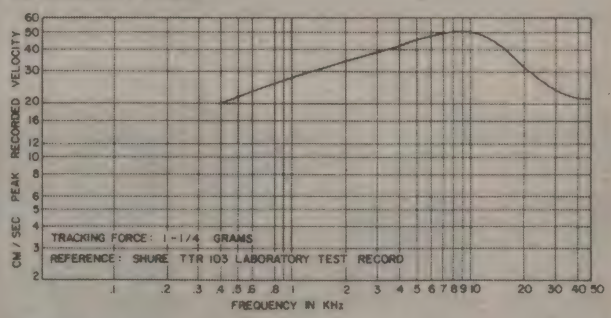
Trackability

400 Hz	20 cm/sec*
1,000 Hz	28 cm/sec*
5,000 Hz	47 cm/sec*
10,000 Hz	50 cm/sec*

* Peak recorded velocity.

(Measurements made using a Shure/SME Tone Arm.)

TRACKABILITY CURVE



Stylus Model N24H: 8 x 18 microns (.0003 x .0007 in.) hyperbolic diamond tip.

Weight Net ..... 5.8 grams (0.2 oz)

STEREO OR FOUR-CHANNEL MATRIX

This Wide-Range Dynetic® cartridge is compatible with all conventional stereo or four-channel matrix systems. Set function switch on amplifier as required.

DISCRETE QUADRIPHONIC OPERATION

For optimum discrete quadriphonic performance, be sure to use low-capacitance cables (less than 100 pF). Adjust decoder or receiver separation, level and other controls as required.

SHURE®

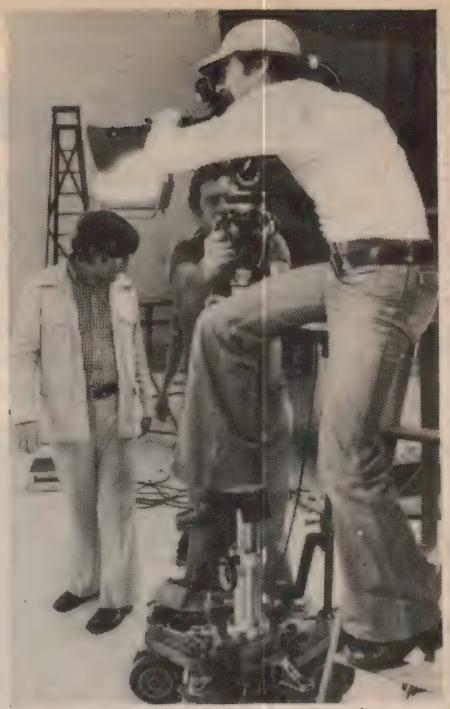
AUDIO ENGINEERS P/L
342 Kent Street
SYDNEY 2000. N.S.W.

AUDIO ENGINEERS (Vic.)
2A Hill Street
THORNBURY 3071. Vic.

RON JONES PTY. LTD
57 Castlemaine Street
MILTON 4064. Qld.

ATHOL M. HILL P/L
1000 Hay Street
PERTH 6000. W.A.

AE107/FP



At left, a scene from one of the commercials—a merit award for the Technics direct-drive fully automatic turntable. Centre: "Thanks mate" to the Author from Haco Marketing Manager Peter Lee; in the background: Charles Mays of "Stereo Buyers Guide". At right, David Gribble checks the viewfinder of the dolly-mounted 35mm film camera; also in the picture Producer Peter Cellier of Teletape Productions.

tape Productions Ltd, of North Sydney. For one week, that set them back around $45,000.

Most of the National brand advertisements were made using video equipment from ATN-7, recording directly on video tape. They were planned accordingly, with no more than a minimum number of visual tricks, to slow up or complicate shooting.

The Technics commercials were a different story, however, with narrator, group shots, rapid cuts to individual editors, close-ups on individual pieces of equipment, all following in rapid succession, many with lip sync and with music over. The video gear was stowed away and out came an Arrieflex 35mm film camera and a portable tape recorder with boom microphone.

Why film, in these days when such superb quality is available from video tape, and when there is no end to the tricks that can be pulled by electronic means?

Checking back with the Agency, we found that they were very wary about the interaction which can occur between the scanning lines of a television image and the sharp near-horizontal lines of hifi equipment in close-up. Where attention is to be focused on the product, problems can be minimised by using a film master and transferring to video tape only for distribution.

When we arrived at the studio early on a Thursday morning in mid June, it was to find a large array of Technics hifi equipment set out on the white tiled floor and against the huge white backdrop which covers one entire wall of the largest Artransa Park studio. It had all been set up during the previous evening and, with a fair amount of lighting already in position, things seemed almost ready to go—to the unpractiched eye!

But, for the first couple of hours, the main set was neglected while the producer and crew concentrated on getting into the can a narration sequence by television personality Barry Freedman.

A couple of hours for a few sentences?

For something that happens only once, live on camera, there is room for a good deal of spontaneity and even a fluff or two. Everyone is human.

For something that is to be recorded and replayed any number of times, a production fault becomes progressively magnified. So every aspect of Barry Freedman's segment was under test and re-examination: make-up, walk-on, posture, expression, intonation, gestures, timing against the stop-watch and so on. Heaven knows how much 35mm colour film rolled through the camera until the producer was satisfied that he had just the take he wanted, plus at least one spare, in case of emergency.

Only then did attention revert to the

FOR MS: NEW SITUATION

Pictured below are the bright new headquarters of MS Components (Electronics) Pty Ltd at 164-166 Redfern Street, Redfern, NSW 2016. As their name implies MS Components stock a comprehensive range of electronics components and test equipment. As well, their new display of hifi equipment highlights their efforts in this market. Do-it-yourself hifi enthusiasts will be pleased with the special emphasis on high quality loudspeaker kits which include precut timber and all necessary hardware.

3 moves into Cassette Hi Fi from $270

Move in with the Sony Cassette Recorder TC135SD for $270. For greater sophistication choose the TC136SD or the TC138SD. Both under $500.

They all exceed Sony's own tough criteria for true Hi-Fi.

Check the specifications. There's one that meets your needs, suits your budget.

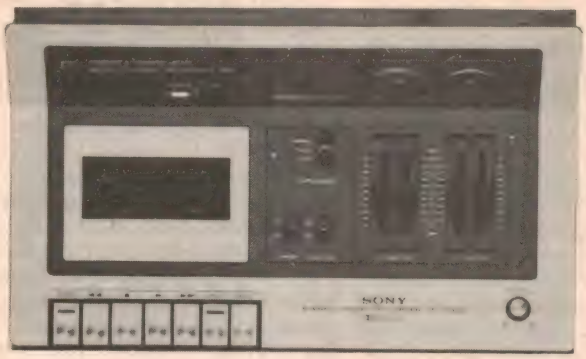
Whichever your choice you have the quiet satisfaction of knowing that it's backed by Sony craftmanship, Sony care, Sony warranty.

Nobody else can say the same.

TC135SD $270*

Frequency response: 30Hz-15kHz with Sony Fe-Cr, Cr02. Signal to noise: 59dB at 1kHz with Dolby on. Wow & flutter: 0.1%

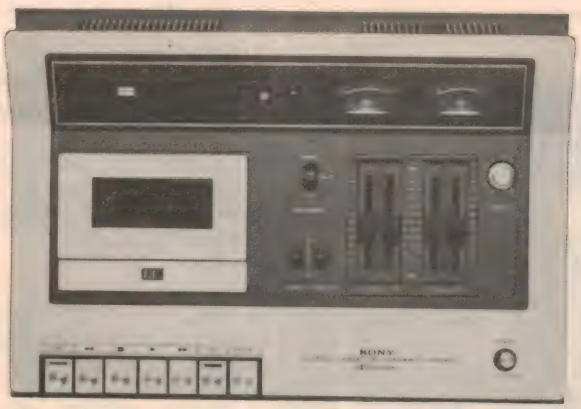
- Line/microphone selector
- Auto shut-off.
- Ferrite & Ferrite head.
- Tape selector for all tapes.
- Dolby noise reduction system.



TC136SD $320*

Frequency response: 30Hz-16kHz with Sony Fe-Cr, Cr02. Signal to noise: 59dB at 1kHz with Dolby on. Wow & flutter: less than 0.1%

- Line/microphone mixing
- Mechanical auto-stop
- FM pilot signal filter
- Ferrite & Ferrite head
- Tape selector for all tapes
- Dolby noise reduction system



TC138SD $420*

Frequency response: 20Hz-17kHz with Sony Fe-Cr, Cr02. Signal to noise: 64dB at 1kHz with Dolby on. Wow & flutter: 0.07%

- Line out level control
- FM pilot signal filter
- Memory counter
- Direct coupling system
- Line/microphone mixing
- Peak level indicator
- Ferrite & Ferrite head
- Dolby noise reduction system

* recommended retail

SONY.®

Hear the difference research makes

For your nearest stockist call SONY Sydney 20221, Canberra 95 2100, Melbourne 874 8222, Brisbane 44 7504, Adelaide 268 3444, Perth 81 3422, Newcastle 61 4991, Wollongong 84 8022, Launceston 25322, Townsville 71 4105.

GAC.S.7649

HIFI NEWS—continued

main set and it was the cameraman's turn to scrutinise critically what the Haco staff had so laboriously set up during the previous evening. Seen through the camera viewfinder, equipment had to be moved about to distribute the shapes better and occupy blank areas. Then the various people were placed in position and further adjustments made to make best use of the field of view.

Meanwhile the lighting crew were up in the gantry arranging general lighting, and setting up spots at floor level. In fact, lighting of the general set was only part of their job. In later shooting, when the camera had to move in on a particular piece of equipment, lighting had to be modified time and again to optimise the close-up shots. Having been involved in any number of ordinary still picture-taking sessions, I gained the impression that the TV commercial lighting crew started where most of us leave off!

It was well after lunch by the time most of the editors got to do their thing and, once again, there were multiple takes before the producer, cameraman and sound recordist were satisfied that they had captured what they wanted. Every take had to be done against the stop watch to ensure that they could, in fact, be assembled into a complete film precisely 60 seconds long.

Methodically, they went through their production schedule, ticking off each individual segment that needed to be shot to make up the original film. About 7.00 o'clock in the evening, the job was done and we headed off home, leaving the Haco staff to move all the equipment out and get ready for the next day's shooting—endless cartons of National whitegoods.

A whole day had been used up to get the raw material for just two 60-second commercials!

But, of course, there were many hours of work ahead for those concerned to process and sort out the film and sound takes, select the most likely ones and assemble them roughly in the right order.

What they were working towards was a pair of films of matched length, one containing scenes 1, 3, 5, etc, interspersed with blank stock, the other containing scenes 2, 4, 6, etc. Matching them would be sound tracks containing speech and background music. The final operation would be to run the sources synchronously, translating and merging their outputs on to video tape using electronic fade, overlap or cut, as desired, plus any necessary photographic compensation.

And that's the way you would finally have seen the commercials on air. As we said earlier, there's nothing to it—provided one has access to a script writer, a studio plus equipment, a production crew, people to manhandle a van full of equipment, a processing lab and a few thousand dollars to pay for it all.

Oh, and one other thing: if you want to ensure saturation coverage on nation-wide television, you'll also need about $300,000 extra!

For the connoisseur who aspires to something approaching the ultimate in cassette record/replay, this rack-mounted Nakamichi equipment should have a strong appeal. At the top, the highly rated model 600 front-loading cassette deck. At the bottom, the new 100W per channel power amplifier, mentioned earlier. In between, the new 610 control preamplifier, with a variety of input, output and mixing circuitry—and no tone controls, by deliberate choice.

CONSUMER ELECTRONICS SHOW—cont.

the 7 has a 12-inch model as well as an 8-inch upper-bass driver. Both systems feature amplifier clipping indicators which glow red when this type of distortion occurs. (Fine for people with "cloth ears".) There is an adjustable control for sensing and the speakers themselves are protected by circuit-breakers which also operate indicator lights. Both models also incorporate "dynamic tonal balance compensation" which translated means that a thermal device operates to lift bass at low listening levels.

B.E.S. Geostatics (Bertagni) released a range of flat speaker systems at last year's Show. All use expanded polystyrene diaphragms clamped at the edges so they vibrate instead of moving like a piston. This year, several new models were introduced, some using piezo-electric transducers for the high frequencies. Incidentally, high frequency drivers are mounted at one of the corners with the main driver in an off-centre position.

Phase distortion is a controversial topic in audio circles just now, with experts about evenly divided as to whether it can be heard or not. Proponents argue that speaker units in systems using crossovers should not be mounted in the same plane to ensure a coherent waveform and they back up their claim with oscillograms of square waves and so on. But others say that room reflections and the program material itself changes phase relationships and that the most stringent tests fail to show significant differences when multiple units are physically moved for "correct phasing".

Be that as it may, at least one English manufacturer, B & W, take the trouble to mount the speakers in a stepped arrangement in their systems. Model DM-6, a three-way system was being demonstrated and, not far away, an American contender, Sonic Energy, had a similar-looking system which was called "Time Aligned". However, the three units in the DM-6 were stepped but the SE had the midrange and treble units in the same plane with only the bass driver out in front. This kind of construction certainly poses problems for the industrial designer and the rather awkward shape takes some getting used to!

ESS added some new models to their range of systems using the Heil "air motion transformer" principle and Dr. Heil told me that magnet efficiency had been improved and the latest models used Teflon diaphragms. A full range model is still in the experimental stage but headphones using Heil units have been on the market for nearly a year. Sound quality is clean with the kind of transparency associated with electrostatic units.

But the system I found the most intriguing was the Stereopillow shown by the Yeaple corporation. It is made of polystyrene foam in which two four-inch cone speakers are embedded. As the cones are quite close to the listener's ears, the small baffles are quite adequate and a passive equalizer lifts bass and treble. Overall sound was excellent but after a day at the Show I appreciated a pillow—without the music!

Kenwood amplifiers. For people who care about "clean" power.

When you select an amplifier, you're selecting the heart of your audio system. And there's no more reason than that to pick a Kenwood.

You see, Kenwood has earned its fine reputation by building integrated amps that deliver "clean" power. In other words, low total harmonic distortion over a wide band. The result is superb levels of clarity that let you really enjoy the music.

No matter which model you choose, you'll be getting an amp that features the best in technology, performance and styling in its class.

KA-3500. With ample power reserves of 40 watts RMS per channel (8Ω) 20—20,000Hz, and a THD of 0.1%, this model is truly outstanding. Convenient features include inter-tape dubbing, loudness control and precise, flexible controls.

KA-5500. Tremendous value. A low-distortion amplifier with ICL. (Input Capacitorless) low-noise FETs and large power meters for professional quality sound reproduction. Delivers 55 watts RMS per channel (8Ω) with less than 0.1% THD throughout 20—20,000Hz.

KA-7300. Two completely independent power supplies dramatically reduce dynamic cross-talk. Delivers a marvelously heightened and clear stereo spread. ICL equalizer circuit. 65 watts RMS per channel (8Ω) from 20—20,000 Hz, with less than 0.1% THD throughout the audio spectrum.

KA-8300. Kenwood's giant. 80 watts RMS per channel (8Ω) throughout 20—20,000Hz and a whole host of distortion-reducing features for purity in sound, including a unique pure complementary Darlington Power Block with ASO protection circuitry. Direct reading accurate Power Meter. A true professional.

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Pioneer CS-T5 Loudspeaker has carbon fibre woofer

Pioneer Electronics Australia Pty Ltd have recently released several loudspeaker systems, including the CS-T3 system reviewed here. The CS-T3 is a three-way bass reflex system employing a 25cm woofer with a carbon fibre cone.

A most noticeable feature of the Pioneer CS-T3 is the transparent grille cloth which allows the loudspeakers to be seen under normal room lighting. This is fine for people who like to admire an impressive array of loudspeakers but could otherwise be a mixed blessing if you feel that loudspeaker systems should be as unobtrusive as possible.

And no doubt the CS-T3 is an impressive system to look at, as are most loudspeakers of Japanese origin. The well-built cabinet is finely finished in a synthetic wood-grain laminate which is difficult to distinquish from timber veneer, but has the advantage of a more robust surface. The clip-on grille cloth frame is easily removable to put the loudspeakers on full show.

The rugged looking woofer is a nominal 25cm unit with massive cast frame, foam roll surround and a heavily ribbed cone. Pioneer describe it as a "carbon fibre" cone but we assume that this means it is a conventional paper cone with carbon fibres added to improve rigidity.

While on a smaller scale, both the tweeter and midrange are equally well finished and fitting mates to the woofer. A small panél accommodates two level controls for the tweeter and midrange. These are calibrated for about half their rotation, presumably in decibels.

Crossover frequencies are 1kHz and 5kHz. Input power rating is quoted at 60 watts. Again, this would normally be interpreted to mean that the unit could handle the full output of a 60 watt amplifier on music signals.

It appears that Pioneer is still using the traditional approach in its loudspeaker design in that the largest possible woofer is installed in the cabinet. More recent design trends have been to design this size of bass reflex cabinet around a smaller woofer, as a larger woofer entails some awkward compromises. One of these is the relatively small diameter tuning port, which is so long that it is bent to avoid interference effects with the rear wall of the cabinet. The small port diameter (relative to the woofer) can be a source of distortion due to the high air velocities produced. This is generally manifested as "frequency doubling" at low frequencies.

The impedance curve of the system is characteristic of bass reflex systems of traditional design in that it has two peaks of roughly equal amplitude, at 12Hz and 60Hz. There is also a substantial dip at 1kHz to almost 4 ohms, which may cause problems with some amplifiers critical in terms of minimum load impedance.

Efficiency of the system was above average and it could be effectively paired with amplifiers of 10 watts rating or more. Frequency response is typical of many Japanese loudspeakers, with a fairly prominent middle register and a lumpy bass characteristic. The system seems very bright, particularly on pop music. We found that with the tweeter and midrange controls set to "flat" there was a tendency to emphasise surface noise on records. A better setting is "minus 3" on both controls, which also results in a more "relaxed" sound particularly on classical music.

Power handling seems well in line with Pioneer's rating, although excessive bass boost should be avoided at high power levels because of the likelihood of "doubling". This renders the sound quality unnaturally boomy.

Overall, the Pioneer CS-T5 is a system which will have considerable appeal to rock music fans, especially with its "presence" effect enhancing vocals. Classical music listeners should assess it carefully to determine whether it meets their requirements. Recommended retail price is $189 each.

Further information and demonstration can be obtained from high fidelity retailers or Pioneer Electronics Australia Pty Ltd, 178 Braeside Road, Victoria, 3195 or interstate offices. (L.D.S.)

Note the transparent grille cloth, which shows off the drivers in the CS-T5.

Sony TC-204SD stereo cassette deck

Front-loading cassette decks are now very popular because they are more suited to shelf-mounting then top-loading types. Here we review one of Sony's latest models, the TC-204SD which has two heads and comprehensive control facilities.

One of the practical advantages of a front-loading cassette deck is that it does not have a horizontal control panel to accumulate dust—and it is a tedious task to clean the dust from a crowded panel. Any dust which accumulates on the bare top cover of this deck can be easily wiped off.

Another advantage which is often cited by hifi dealers is that front-loading decks can be stacked on top of other equipment. Not so. In spite of the fact that some decks, including that under review, have an all-enclosing steel chassis and cover, they are subject to hum induction from the transformers in other equipment. This fact may be unnoticed in a noisy setting (such as the showroom) but will cause hum problems in quiet domestic surroundings.

Apart from hum induction, there are two more pressing reasons for not stacking cassette decks on top of other equipment, particularly amplifiers. First, the cassette deck is likely to restrict ventilation of the amplifier. Second, the switch-on surge in the amplifier's power transformer may cause partial magnetization of the record/replay head.

It is wise practice to keep high power amplifiers as far away as is practicable from a cassette deck, to minimise the above problems.

Overall dimensions of the Sony TC-204SD are 430 x 160 x 325mm (W x H x D) including knobs, feet and rear projections. Mass is 8kg. Finish on the front panel is "scratch-grain" aluminium while the timber wrap-around cover is in walnut veneer.

Cassette loading is easy. It just drops into a channel in the cassette compartment lid. The lid is then pushed home. Since the cassette is held vertically behind a large window in the lid, it can be seen easily. There is a light behind the cassette so progress of the tape can be clearly seen.

Pushing the eject lever flips the lid out but the cassette is held in its channel, so there is no way it can fall out.

These are all important points to look for when buying a cassette deck. Any shortcomings can be very irritating after the initial pride of ownership has worn off.

Transport control levers are firm and positive in action without being too heavy. An automatic stop system is incorporated. The only feature lacking in the transport mechanism is a "Memory rewind" facility, but this is no great hardship.

Microphone and line mixing facilities are provided via concentric knobs for both channels. The meters are adequate with a reasonably accurate calibrated range from -20 to +3VU. A peak overload led indicator monitors the signal in both channels while recording, and lights when the level exceeds +4VU.

The other worthwhile aid to recording is Sony's most effective limiter. Best recording results are obtained by setting the recording levels so that the overload indicator flickers intermittently during loud passages—then switching in the limiter. The limiter only acts upon signals in excess of OVU, and causes little distortion.

Dolby noise reduction is included as a standard feature. There is also a Dolby filter for recording FM broadcasts. This

rolls off the response above 15kHz, so that 19kHz pilot signals do not interfere with the Dolby circuits. The filter can be switched out for Dolby recordings from other sources.

6.5 mm jack sockets are provided for two low impedance microphones, a stereo line plug and stereo headphones. Signal level from the headphone socket is not affected by the line output control.

The interior layout of the TC-204SD is a surprising contrast with most other cassette decks. Its large and commodious chassis is a marvel of accessibility by comparison with other machines. For example, the whole transport mechanism can be removed without having to disconnect and remove umpteen PC boards. The compact transport mechanism has a number of interesting features. Of great interest to the serviceman is the fact that the belts, with the exception of that for the revolution counter, can be easily changed. The motor is a DC type with a transistor drive circuit which appears to regulate the speed by monitoring the motor back-EMF.

We were interested to note that the automatic stop feature is entirely mechanical in operation. It is a worm-gear driven mechanism which is latched when the take-up spool (referred to forward tape direction) is stopped. This system seems preferable to electromechanical systems which employ a solenoid to disengage the tape transport.

Most of the circuitry of the deck is accommodated on one large PC board which is mounted upside down in the chassis. A worthwhile improvement in accessibility to this board could be provided by an access panel in the underside of the chassis. Even so, it is relatively straightforward to detach the PCB if a component repair is ever necessary.

As with all Sony mains-operated equipment, the three-core mains flex and moulded plug are detachable. No problems were experienced with "earth loops", which is as it should be. Nor were there any problems with RF breakthrough.

The cassette compartment lid is easily removable but, even so, access to the heads for cleaning is not easy. The most convenient method for head cleaning would be to use a head-cleaning cassette. We wonder why the manufacturers do not bother to suggest this method, rather than the alternative procedure with cotton buds and denatured alcohol.

The comprehensive instruction manual is written in four languages and it is a most useful aid to obtaining best performance from the machine. Included are notes on maintenance, troubleshooting and the specifications.

Frequency response specifications are quoted specifically for Sony's ferrichrome tape and for chromium dioxide tape. The specification for "regular tape" was a little vague. We chose to test with Sony Ferrichome and BASF Chromium dioxide. The machine could be expected to give optimum performance with the former tape.

With Dolby noise reduction disabled the frequency response at -20VU was within plus or minus 3dB from 20Hz to 16kHz using Sony ferri-chrome. This is actually a little better than the manufacturer's specification. With Dolby noise reduction in use (but the Dolby filter out of circuit) the response was not quite as smooth or as extended. It is significant that Sony do not quote a spec for frequency response when Dolby is employed.

Results with BASF Cr02 tape were within a whisker of the previous tape although again there was the typical slight deterioration when Dolby was employed. So as far as frequency response is concerned (with these tapes) the TC-204SD must be listed as one of the better performers. To put it another way, very few cassette decks will better it.

Separation between channels was adequate, though not spectacular, at an even 30dB over the range from 100Hz to 6kHz. Total harmonic distortion at OVU and 1kHz was approximately 2% which rose to approximately 2.5% at +3VU. These measurements are difficult to make really precise since speed fluctuations prevent a perfect "null" being achieved on a distortion meter.

Wow and flutter is quoted at 0.2% DIN or 0.09% RMS. We found the wow and flutter dependent on the particular cassette used, but were able to record a best measurement of 0.2% DIN.

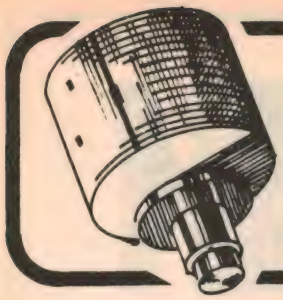
Signal-to-noise ratio with Sony ferrichrome tape and Dolby noise reduction was 49dB unweighted. Without Dolby, the figure was 46dB unweighted. Similar results were obtained with BASF chromium dioxide tape. While these figures are not remarkable the deck was adequately quiet in use, provided it was not sited next to an amplifier with a large transformer.

Rewind time for a C-60 cassette averaged around 85 seconds.

As can be expected from the test results, the performance on music recordings was very good. With Dolby recordings we were able to obtain results which were often virtually indistinguishable from high quality discs. Previously, we have only been able to obtain this sort of performance from relatively more expensive decks.

Overall, we must rate the Sony TC-204SD as a very good performer. At the recommended retail price of $330 it is a good buy. Accessories included in the price are the instruction manual, patch cords, head cleaning tips and a blank ferri-chrome cassette.

Further information can be obtained from high fidelity retailers or from the Australian distributors for Sony equipment, Sony Kemtron Pty Ltd, 453 Kent Street, Sydney, NSW 2000. (L.D.S.)



News Highlights

Nuclear power is relatively safe says OECD report

The Nuclear Energy Agency of OECD has just published an assessment, prepared by Sir Edward E. Pochin, MD, FRCP, of the total doses of ionising radiation which a population may expect to receive from all sources, natural and artificial, under various conditions and notably conditions resulting from the production of nuclear power.

In most industrialised countries, electricity consumption from all sources is currently of the order of 1kW per head of population. Dr Pochin based his estimates of the effects of nuclear power on the assumption of this entire amount being produced in fission reactors rather than, as at present, nine-tenths of it being produced by sources other than nuclear.

This assumption leads to the conclusion that normal exposure always received by the population from natural sources (of radiation) would be increased by an average of about 6 per cent. "This compares", continues the report "with average increases in the region of 35 per cent from radiological procedures, 6 per cent to the present generation from the fallout from nuclear tests, and about 0.06 per cent from other artificial sources".

A detailed estimate is made of the possible health and genetic effects of this additional exposure to radiation. It is concluded that there would be "a risk per year per million of population of about 1 fatal induced malignancy, about the same number of malignancies fully treatable by operation, and, after many generations about the same number of inherited defects of greater or less severity, per year".

The report also examines (though in less detail) the equivalent risks related to supplying the same amount of electricity (1kW per head) from other sources, notably coal, oil and natural gas. The hazards appear to be considerably greater in the case of coal, somewhat greater for oil and possibly somewhat less for natural gas.

The report does not draw any conclusions as to the desirability or otherwise of nuclear as compared to other forms of power. It does however stress that all forms of power production carry measurable risks which must be weighed against the benefits resulting from the power being available.

Note: Sir Edward Pochin, a former Director of the British Medical Research Council's Department of Clinical Research, was Chairman of the International Commission on Radiological Protection (ICRP) from 1962 to 1969. In 1956 he was UK representative on the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). He is currently a member of the British National Radiological Protection Board (NRPB).

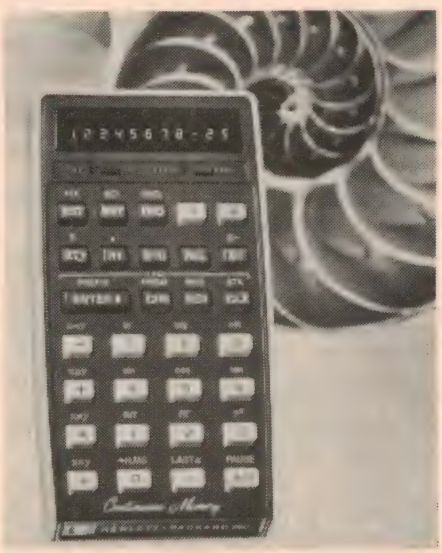
New H-P calculator has non-volatile memory

The first Hewlett-Packard programmable scientific pocket calculator with a memory that retains stored information even while the calculator is turned off was introduced recently by the company.

The new HP-25C is identical to the HP-25 keystroke programmable scientific pocket calculator introduced by HP last year, with the addition of the continuous memory. Both calculators are designed to provide simplified, yet comprehensive programming capability for engineers, scientists, students, technicians and others who handle repetitive calculations.

Continuous memory enables a user to save time and extend battery life by reducing the number of times information or program steps have to be keyed in to the calculator. For instance, often-used conversion constants can be recalled minutes, days or weeks later at the touch of a key.

Programs that are used over and over again can also be stored, so that they don't have to be re-entered every time they are needed. Any stored information can, of course, be cleared or changed at will.



The new calculator has 49 steps of program memory, coupled with merged keycodes that conserve steps to effectively expand memory capacity. It also has eight addressable memories, with full register arithmetic. In addition, the HP-25C has full editing capability, performs direct branches and has the ability to make any of eight conditional tests within a program.

New gas improves integrated circuit reliability

A special gas developed and supplied by Linde Gas Pty Ltd is being used to further improve the reliability of integrated circuits.

Linde Gas is the Australian subsidiary of Linde AG, the West German-based diversified industrial group and one of the largest industrial gas companies in the world.

The various elements in an integrated circuit are normally inter-connected by aluminium. But aluminium has been shown to be subject to corrosion problems, and for equipment where a very high standard of reliability is required the practice has evolved of using a tri-layer of the three noble metals—titanium, platinum and gold—instead of aluminium.

The tri-layer process gives a very stable system, not liable to corrosion, and is used in high reliability integrated circuits now being manufactured by AWA Microelectronics.

The entire process, originally developed for military components, will be applied to other integrated circuits manufactured by AWA Microelectronics, including those used in cardiac pacemakers.

Viewdata pilot trial—business interest grows

More than seventy organisations—ranging from British Rail to the Financial Times—are now arranging to take part in the pilot trial of Viewdata, the Post Office's system for presenting telephoned information on television sets. And the number of interested organisations continues to grow.

Viewdata is a revolutionary communications concept making use of the ordinary telephone lines and a modified television receiver. A pushbutton control unit, which will eventually be provided with the receiver, enables the user to call up information over the telephone and display it in words or diagram form on the TV screen.

The system will make available a huge store of information on subjects of interest and value to all members of the public. This wealth of information will range from up-to-the-minute news to household hints, and also includes such subjects as sport, leisure activities, jobs, careers, motoring, travel, holidays, education, money, business services, share prices and facts and figures.

The pilot trial of Viewdata, which started at the beginning of the year, is the first step towards a public service which could start within three years. Taking part with the Post Office in the pilot trial are television receiver manufacturers and a wide range of organisations providing information.

At last—an IC chip for domestic appliances

A tiny chip of silicon a few millimetres square was the star exhibit—in the sense of being the one major technical advancement—at the International Home Electronics and Domestic Appliances Exhibition (HEDA) at the National Exhibition Centre, Birmingham, last May.

The chip, a large-scale integrated circuit which can perform 5000 separate functions, was introduced by Servis Domestic Appliances as the compact electronic controller of its new 7-program push-button Selectronic washing machine. It replaces the present complex electro-mechanical switching used worldwide which is said to be the biggest single cause of machine breakdowns.

However, the chip has a greater significance, which brought it a lot of attention from overseas visitors. As Servis point out, the unit could be used to run all the equipment in a home, from central heating and air conditioning to cooker and toaster. The device is expected to give Britain a world lead and Servis is prepared to discuss licensing arrangements with overseas manufacturers.

The address of the company is Kings Hill, Wednesbury, West Midlands, England.

Lowering the boom on colour TV prices

A new booklet being distributed by the Electronic Importers' Association graphically illustrates the price benefits to consumers of international competition amongst household electronic goods.

The booklet lists a number of imported items that have actually fallen in price during the last year. These include: colour TV receivers down 15%; b&w TV receivers down 25%; transistor radios down 30%; cassette recorders down 25%; and radio-cassette recorders down 25%. According to the publication, "Australia is the only country where the retail price of world famous brands of colour TV receivers has actually fallen right from the introduction of colour transmission".

The Association also claims to have played an important role in "preventing shortages of colour sets in the early days of transmission". The booklet goes on to say that to the end of October, 1975 "Australian manufacturers produced 380,000 colour sets whereas Australians actually purchased 750,000 sets. So if there had been no imports there would have been an acute shortage, and everyone knows what would have happened to prices".

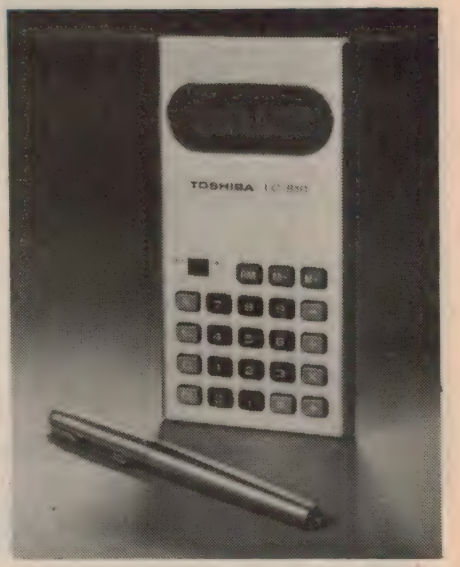
However, a media release accompanying the booklet sounds a word of caution on reports predicting further price reductions. The release points out that as well as not being exempt from local cost-induced price increases, costs for imported electronic goods can also be directly affected by the continuing erosion of the Australian dollar against the US dollar and the Japanese yen. As well, recent improvements in the US and Japanese economies are likely to lead to strain on the supply of components, which will add to the pressure on costs.

Pocket calculator has liquid crystal display

Toshiba-EMI (Australia) Pty Ltd is now marketing a compact but very versatile pocket calculator, the LC-810, which is designed to give more than 1200 hours continuous operation under full load conditions.

Powered by two tiny silver oxide dry batteries (similar to those used in automatic cameras), the new calculator fits comfortably into a shirt pocket, weighs only 90 grams (approx. 3 ozs) and has a thickness of only 9.5mm

The LC-810 utilises an 8-digit black liquid crystal display and, in addition to the standard 10-key numeral system, features a fully addressable memory system, a fully floating decimal point, a sign change key and a percentage key.



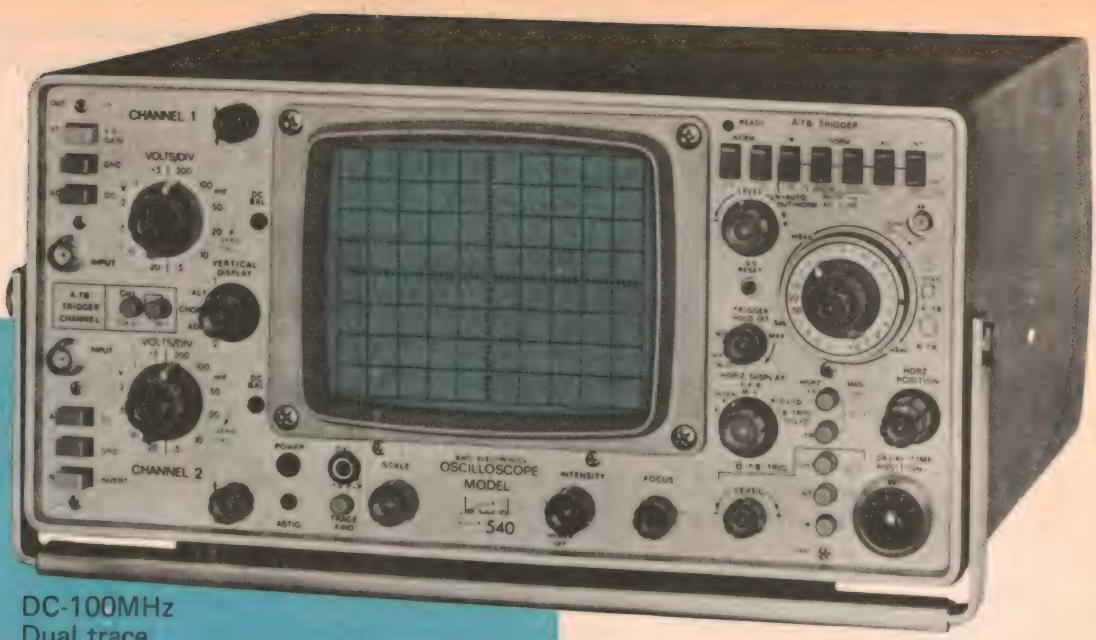
New satellite will handle 14,400 telephone links

Shown at right, an engineering replica of the Orbital Test Satellite (OTS) spacecraft, capable of handling 14,400 simultaneous telephone links, undergoes tests in the anechoic chamber of its prime contractor in southern England.

The tests were designed to measure the propogation characteristics of the equipment in a simulated space environment by blocking off ground level electrical interference and signals reflected from nearby buildings or other obstacles.

OTS will provide facilities for a significant portion of inter-European telephone, telegraph and telex traffic in the 1980s while satisfying the requirements of the European Broadcasting Union for television relay.

Scheduled for launch into geostationary orbit in 1977, OTS is being developed for the European Space Research Organisation (ESRO) with the primary aim of developing a space communications system in an adaptable modular form.



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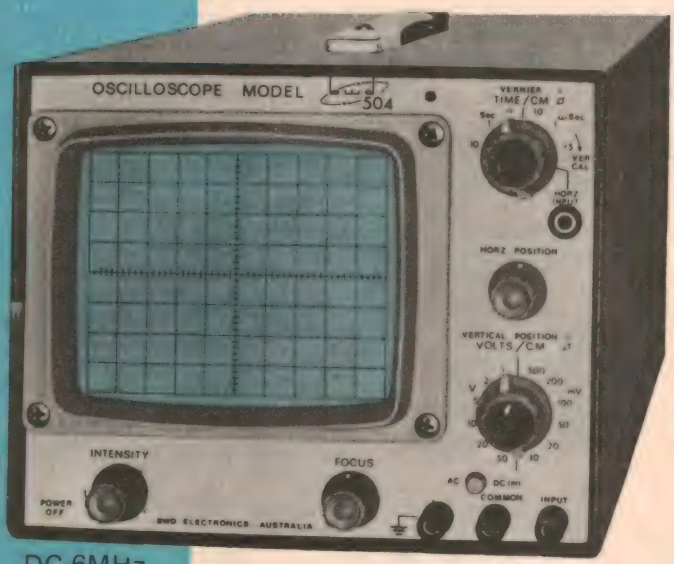

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FP376

NEWS HIGHLIGHTS

New lightstick is heatless, needs no batteries

A remarkable new heatless lightstick, developed in America, is now available in Australia.

The lightstick is unique in that it operates by chemicals and not by batteries or electricity. It is only 14 cms long, the thickness of a finger, is absolutely cold when in use, weighs less than 20 grams, and will even work under water.

The discovery and application of the cold light was made by the giant American company Cyanamid. The lightsticks, called Cyalume, are being imported by GEC-AEI Australia Pty Limited.

The apparently magic tube relies on chemiluminescence—the conversion of chemical energy directly to light without electrical input or wasteful heat output. Light is created when two liquids inside the tube are mixed after bending the tube slightly to break an inner container.

The lightstick and its contents are perfectly safe. The tube is almost impossible to break and even if it does, the liquids inside are non-toxic and therefore virtually harmless, although it can stain material if not washed out.

When operating, the lightstick can shed light equal to, if not better than, a candle for up to four hours. Importantly, as a safety marker it glows for ten hours. The chemicals are then inactive after this time and cannot be re-charged.

The non-ignition qualities of the system make it ideal for situations where gas or fumes are present. The lightstick can

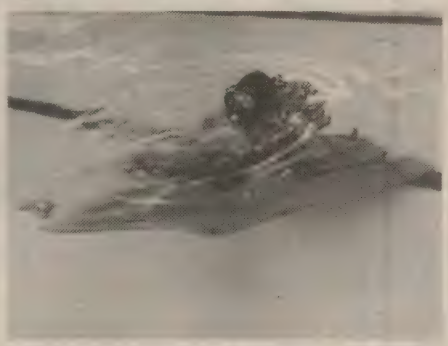
even operate safely in a petrol tank.

For motorists the lightsticks can fit into a glove box and are ideal for all emergency situations; for example, as a light when doing roadside repairs, changing tyres, and especially when checking fuel lines and carburettors. The lightsticks are also ideal for boating enthusiasts, campers, fishermen, and bushwalkers.

Diver transport vehicle for underwater work

The Aquabatic—an underwater diver transport vehicle similar in shape to a toboggan—has been designed to carry divers and their equipment to the sea bed and back.

The machine is propelled by an electric motor powered by two or four batteries with a duration underwater of up to 2½ hours. A special safety cut-out has been installed on the motor which is operated by a magnetic switch, activated by a small magnet attached to a cord round the diver's neck. In the event of the diver being separated from the machine the motor will automatically stop and prevent a riderless vehicle running out of control.



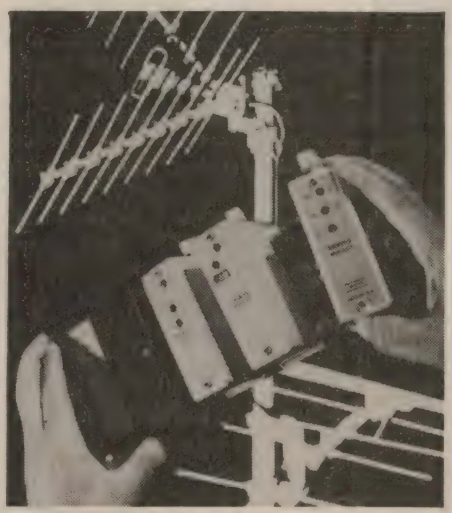
The machine is designed to operate at depths of 150 feet (45.7 m) although this can be extended with certain modifications.

Modular approach to communal antenna systems

A large number of households in Europe rely on a communal antenna system for their TV and radio reception. These antennas are nowadays often installed as part of the basic fixtures of new housing estates and can serve whole communities comprising several thousand residents.

But communal antennas are also suitable for smaller houses, built to accommodate one family or several households, in which there are a number of TV outlets. At this year's Broadcasting Exhibition in Berlin, Siemens presented a new system specially designed for the smaller antenna serving up to 30 outlets. This "Minicaset" system (shown in the picture) is made up of easily installed modules which ensure perfect reception of all the TV and radio channels which can normally be received.

When older buildings are equipped with a communal antenna system the Minicaset helps to gradually do away with the unsightly forests of individual antennas. For further information contact Siemens Industries Limited.



Medical electronics symposium for Melbourne

The Society for Medical and Biological Engineering (Vic), in association with the Australian Federation for Medical and Biological Engineering, will be conducting a 1½ day symposium in October entitled "Instrumentation and Health Care".

Papers on a range of related subjects will be presented by invited speakers, with group discussion after each speaker. Subjects will include: present medical instrumentation and future trends; computers; organ imaging; and automated patient treatment.

The symposium will be held on Friday afternoon, 29th October, and all day Saturday, 30th October, at the Medical Centre, University of Melbourne. For further details and a registration form contact Lindsay Dally, Department of Physiology, University of Melbourne, Parkville, Vic 3052.

Microprocessor Schools

During October and November, NS Electronics will be holding 1-week intensive courses in microprocessor applications, for engineers and logic designers. The courses will be limited to 12 students, and each pair of students will be allocated a major development system for "hands on" experience.

The courses will deal with National's PACE and IMP microprocessors. The first will be held in Melbourne, from 4th to 8th October. The Sydney course will be held from 1st to 5th November. Course fees are $395 per person.

Inquiries to NS Electronics at Cnr Stud Rd and Mountain Hwy, Bayswater, Victoria or 2-4 William St, Brookvale, NSW.

The True Hi-Fi Full-Automatic Direct-Drive Turntable.

Test drive it.

The FR-5080S is the one from Sansui that combines automatic convenience with direct-drive precision. Quite a combination.

It's the one with brushless DC servomotor to eliminate speed drift, keep wow/flutter to an amazing 0.03% WRMS or less and signal-to-noise ratio better than 62dB.

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And the one with independent automatic mechanism, with 16-pole, 3-rpm gear motor that is completely disengaged during actual play from the tonearm linkage.

Almost everything is automatic, by the way. Lead-in, cut, return, repeat and shut-off. That's convenience.

But the performance specifications are something you'd probably only find in a manual. And that's precision.

You already know that a bargain turntable is better than nothing.

But if you want to involve yourself in music, you're going to have to get involved with true hi-fi.

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New techniques in superconductivity

Sixty-five years after its discovery, superconductivity is at last moving into a range of practical applications after long being regarded as a scientific curiosity. Indeed, engineering exploitation of superconducting materials looks set to bring radical changes to the technology of electrical machines and power generation and distribution in the near future.

by C. L. BOLTZ*

At Oxford University in England there is an electromagnet in which a steady electric current of some 20 amperes has been flowing for years without any electrical supply. This current will continue to flow, producing a magnetic flux density of 50,000 gauss (5 Tesla), for as long as required in the future.

The magnet, part of a nuclear-magnetic-resonance (NMR) spectrometer, was wound by the Oxford Instrument Company, Oxford, England, from wire supplied by Imperial Metal Industries, Birmingham. It is but one example of the lead achieved in Britain in superconductor technology.

This technology has developed in less than two decades, though superconductivity—an astonishing and wholly unexpected phenomenon—was discovered as long ago as 1911 by Dutch physicist Kamerlingh Onnes during investigations into the electrical resistivities of metals at very low temperatures. Onnes found that the resistance of mercury did not decrease smoothly with falling temperature as expected but dropped suddenly to zero at a temperature of 4.1°K (−269°C). A current, once started, would thus go on seemingly for ever.

The same phenomenon was soon shown with some other elements, yet for half a century interest in it remained academic.

The first explanation of this strange neglect by engineers is that except in laboratories there was no way of achieving the very low temperatures needed. There is but one material known to man that is fluid at temperatures around 4°K. It is helium, which turns from gas to liquid at 4.2°K. Two world wars passed before the first helium liquefiers or refrigerators were commercially available.

In addition to the very low critical temperatures, above which no superconductivity existed, there were two other limits to progress. The first was the critical current density. In the earliest materials these currents were of the order of milliamperes per square centimetre, useless to the engineer.

The second critical parameter was the maximum magnetic field which the superconductor could withstand. The early superconductors could withstand flux densities of only a few hundred gauss, too small to be interesting to the electrical engineer.

With the commercial availability of helium liquefiers and refrigerators the whole field of cryogenics extended quickly into practical engineering. Hundreds of alloys have had their parameters as superconductors measured, but only a few have emerged as useful.

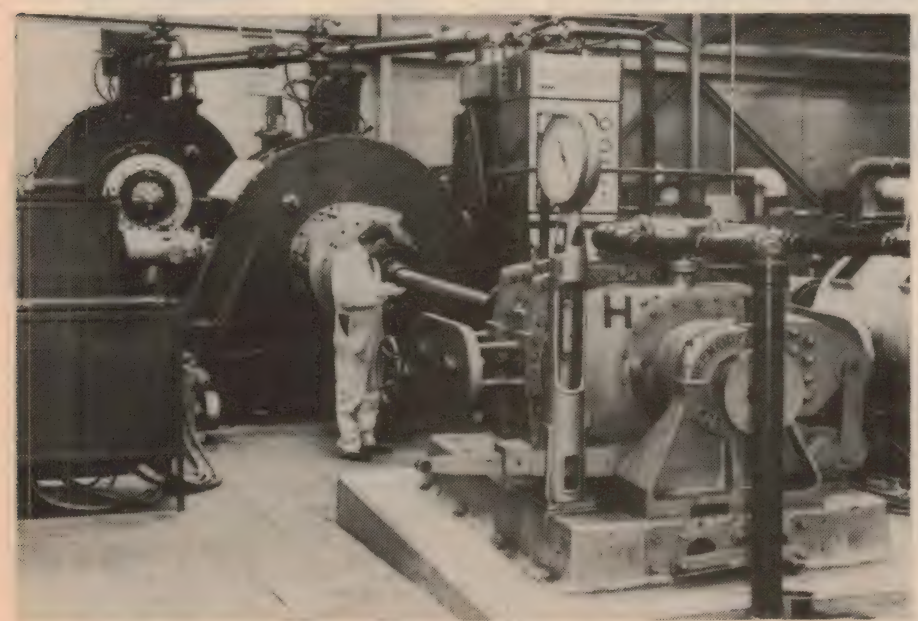
Of the elements, niobium has the highest critical temperature, 9.46°K. Among the alloys, niobium-zirconium was discovered in the late 1950s and niobium-titanium in the mid-1960s, both with critical temperatures in the region of 10°K. Niobium-tin, with a critical temperature of 18°K, excited engineers from 1960 onwards, and niobium-germanium (22°K) more recently.

With these newer alloys the critical current has risen to thousands of amperes per square centimetre and the critical flux density to many tens of thousands of gauss. In the space of little more than a decade electrical engineers and industrialists have become interested in superconductor technology as a frontier development.

Generators and motors a fraction of the weight of conventional machines have become possible. Powerful electromagnets consuming no power and needing no iron, usable in giant atomic particle accelerators, mineral separators (china clay for example), advanced spectroscopes and so on, are a reality.

There is the possibility of underground superconducting cables carrying enormous currents with very low losses, and in a smaller space, for electrical distribu-

*Former science correspondent of the "Financial Times", London.



A 1MW superconducting DC generator and motor for marine propulsion undergoing tests at the International Research and Development Company, Newcastle upon Tyne. IRD made the first large superconducting DC motor.

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tion. Britain has been in the forefront of all this development.

It has been necessary to solve many problems. For example, in practical cables and generators there can be surges and other effects that raise the cable or wire locally above the critical temperature, or increase the magnetic field or raise the current above the critical value. Any of these effects can destroy the superconductivity, and as the material is normally of high resistance there is heating and consumption of power.

The Central Electricity Research Laboratory, England, tackled this problem and saw that if in parallel with the superconductor there was a low resistance, massive, well cooled normal conductor such as copper, the current would divert from the high resistance superconducting material into the parallel conductor and the cooling would restore the superconductivity.

So a composite wire, niobium-titanium in a copper matrix, was developed in association with Imperial Metal Industries (IMI) which has marketed it as Niomax M, one of the earliest of the commercially available superconductors.

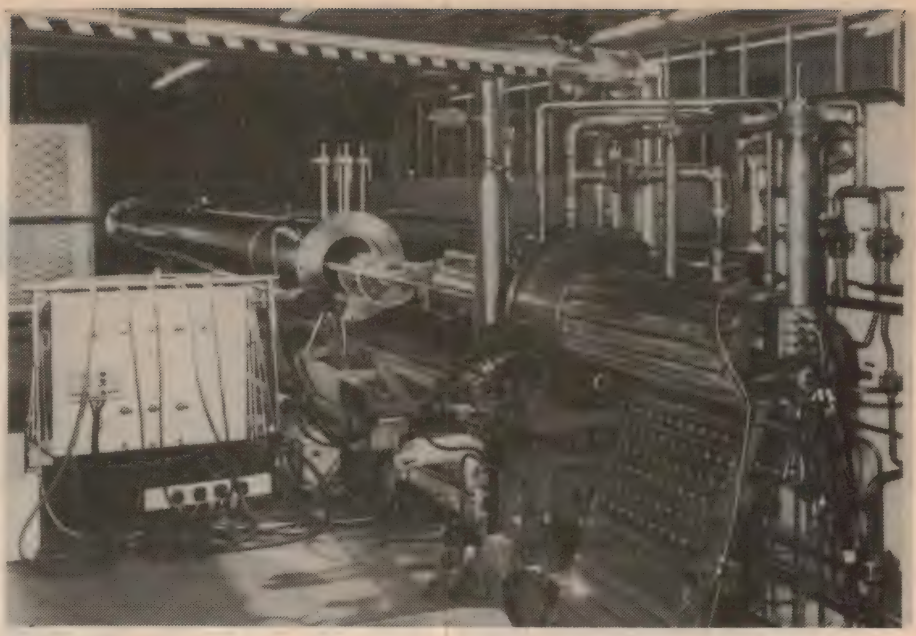
It was soon known that a superconductor would behave perfectly when used as a short length of rod in the laboratory but when drawn into wire in magnets its performance was degraded. This was diagnosed as resulting from flux jumps, which cause instability and loss of superconductivity. Intensive research at Britain's Rutherford High Energy Research Laboratory (RHEL), cooperating with IMI, led to the production of fine filaments of niobium-titanium twisted together as a cable in a copper matrix.

This was the world's first intrinsically stable superconductor. It was called Niomax FM, and patented all over the world by RHEL and IMI. (It is used in the Oxford University electromagnet.) For this achievement the British Cryogenics Council awarded the teams concerned its new prize for the most outstanding contribution to cryogenics in the United Kingdom.

The International Research and Development Company (IRD), Newcastle upon Tyne, has also had striking successes in cryogenic technology. Supported by the National Research Development Corporation it made the first large superconducting DC motor of 3000hp (2240kW). This was of special homopolar design and was tested for a year at the Central Electricity Generating Board's power station at Fawley in southern England, where it was used to pump cooling water.

Its cost was little more than half that of a comparable conventional motor and it weighed only one ninth as much—a good practical example of savings that could be made.

Following this, IRD built a very large superconductive DC generator and motor, a one megawatt system, suitable for use in ships. The prime mover (diesel engine) and generator need not be directly coupled by shaft to the propellers, so a redistribution of engine mass is possible.



Test facility for superconducting cable at the Central Electricity Research Laboratory. The cable is tested in the long tube, which is called a cryostat.

The generators and motors made so far are DC machines as superconductors cannot be used for alternating current in high magnetic fields because of great hysteresis losses. Nevertheless, in the Rutherford High Energy Laboratory steps have been taken in that direction.

Scientists there have used their knowledge of fundamentals and their practical skills to build magnets that will work with pulsed direct current with a rise time on pulse of about half a second. One can only add here that the laboratory is also interested in magnetic levitation to provide frictionless tracks for high speed traffic—research into this is going on at several universities. Superconductivity looks to be a very suitable phenomenon which could be used.

To the industrial electrical engineer the most interesting possibilities are in AC generation and in electrical distribution by superconducting cable. For such a cable, which is more or less straight, the magnetic field is very small indeed and alternating current can be carried.

At the Central Electricity Research Laboratory at Leatherhead, south of London, the technology has been thoroughly explored and specimen cable made. This has niobium as the superconductor, deposited on copper strip, which is wound helically to allow for dimensional changes at the low temperatures used. Problems of insulation have been solved by the use of special polyethylene.

The whole cable is arranged as a concentric with helium flowing along the middle and returning along the outside. Three such cables for the three phases of a system could be accommodated inside an evacuated pipe cooled by liquid nitrogen.

Some costings have been made and they show that such cable would be cheaper than conventional cable for a power of 5000 megavolt-amperes at 400kV, but that until such a power is needed conventional cable remains the cheaper.

AC generation using superconductivity is very attractive because of the increasing size of alternators. There are many problems to be investigated and Britain's Science Research Council has made grants approaching £200,000 to eight universities for research programs.

The superconducting part of any such generator would of course be the DC field. If this is the rotor what happens to helium swirling round at 3000 rev/min? If, on the other hand, the generator is turned inside out, making a conventional rotor carry the AC output, how can one design slip rings to feed the transmission lines? These are but two of the many problems.

The most futuristic possibility of all is the use of superconductivity in the generation of electricity by nuclear fusion. In Britain the Culham Laboratory is the centre for all such research and already RHEL is designing a superconducting magnet for a device called the Levitron. The next big project, believed to be the precursor to a fusion reactor, is called JET.

In post-JET, a real reactor, it would be essential to use superconductivity for the powerful magnetic fields required. It is to such matters that RHEL and other centres are now directing research effort.

How the US maintains its electrical standards

Measurement standards form the basis of most branches of modern science, and this is certainly true for the electrical sciences. In the US, the National Bureau of Standards is charged with the responsibility of maintaining and developing a set of electrical standards for the nation. The following article is a capsule description of this system today.

The famous physicist Lord Kelvin claimed, " ... when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind."

One of the main responsibilities of the US National Bureau of Standards (NBS) is to provide for that country the kind of understanding Lord Kelvin was talking about—knowledge through measurement—for the basic quantities, including electricity.

When the Bureau was founded in 1901, the vast potential of "portable" electric power was just beginning to be realized. A critical need had yet to be met—knowledge of electricity through adequate measurement techniques and measurement standards. In the last 75 years NBS has provided, and continues to refine, a national measurement system for electricity that meets the increasingly sophisticated needs of science and commerce.

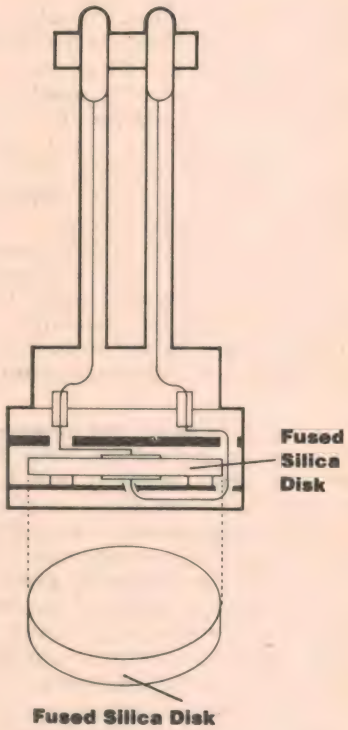
The electrical units now universally employed in the United States are those of the International System of Units ("SI units" for short). They are also the same as the "rationalized MKSA" units familiar to electrical engineers.

If all existing electrical standards were destroyed, it would be possible to reconstruct them accurately on the basis of their definition—provided we also had access to accurate standards of length (metre), mass (kilogram) and time (second). In practice, the "absolute determination" of electrical units, as the construction and evaluation of primary electrical standards is called, is rarely undertaken except by national standards laboratories like the National Bureau of Standards.

The Measurement Strategy

Three units are considered the starting point of the electrical measurement system as it exists today: the unit of current (the ampere), the unit of electromotive force or potential difference (the volt), and the unit of resistance (the ohm). Once the standards for any two of these units are established they can be used to calibrate standards of the third one.

The first step in the NBS measurement strategy is to build a capacitor whose capacitance can be calculated very accurately from its dimensions. Then, by means of an alternating-current bridge, a resistance standard can be calibrated by comparing its resistance with the impedance of the calculable capacitor.

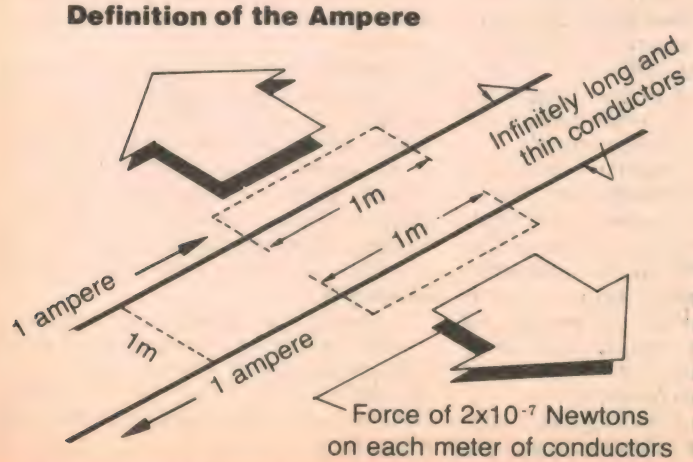


The NBS 10pF reference capacitor is of the parallel-plate type. The 'plates' are the upper and lower silvered surfaces of a circular disc of fused silica. The fused silica disc (approx. diameter 7cm, thickness 1 cm) is also shown separately at the bottom.

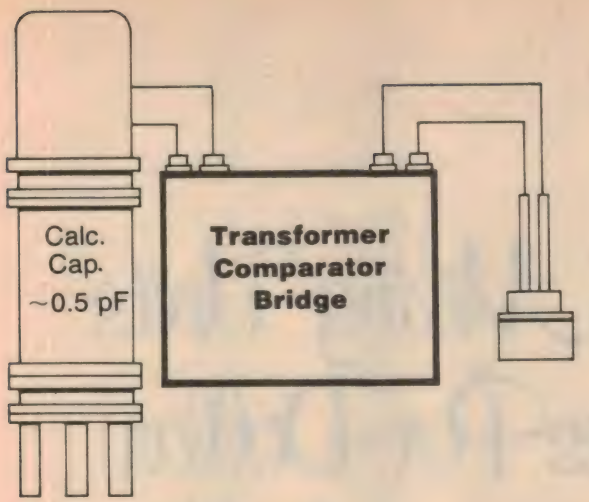
Every 10 years or so an absolute determination is made of the ampere. A current is created in a special apparatus which permits the current to be evaluated in terms of the definition of the ampere. Such a current can be accurately maintained for only a few minutes. This is time enough to use this current, together with the ohm standard, to calibrate voltage cells (batteries specially designed to serve as standards). A group of these cells constitute the working standard of voltage which, unlike the ampere standard, can be available at all times.

In principle, a different measurement strategy might have been adopted. Some, for example, would consider it

Definition of the Ampere



The ampere is defined in terms of the force per metre between two infinitely long wires when a current of 1 ampere is flowing through them.



A bridge circuit is used for measuring the NBS reference capacitor against the calculable capacitor. Bridge circuits play a role in comparing electrical quantities like that of balances in comparing masses.

simpler to start by defining the unit of electric charge, the coulomb, instead of the ampere (which would then be defined as a current flow of 1 coulomb per second). Or, instead of taking a calculable capacitor as a primary standard, a calculable inductor—a coil whose inductance we can calculate from its dimensions—might have been chosen.

This was in fact the procedure followed until the recent improvements in the accuracy of the calculable capacitor gave it a decisive advantage. Deciding which units to start with, and what kinds of standards to embody them in, represents a complex judgement on how to optimize the quality of electrical measurements. Two obviously important technical criteria are that the standards should represent the units as accurately as possible and that they be as stable (constant) as possible.

Consequently, changes in both the starting units and types of standards can be expected from time to time as a result of advances in experimental technique and theoretical understanding. Much hard thought is in fact presently being given, at NBS and elsewhere, to potential improvements or alternatives to the existing procedures and standards.

Some Definitions

(Note: Statements in quotation marks are definitions adopted by the 19th General Conference of Weights and Measures in 1948.)

Current: Physically, an electric current is a flow or drift of charged particles—electrons, in the case of a metallic conductor of electricity. A moving charge, however, is accompanied by a magnetic field, which gives rise to forces between, conductors in which currents are flowing. This fact is utilized in the definition:

"The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible cross section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length."

Electromotive force (emf)/potential difference (p.d.): A device that converts other forms of energy into electrical energy (for example, a storage battery or steam-driven electric power generator) is said to be a source of emf. Such a source has the ability to drive an electric current around a circuit of which it is part. The emf is measured in volts, the number of volts being equal to the number of joules of energy imparted by the source to each coulomb passing through it.

The current maintained by an emf is produced by electric fields that drive the mobile current carriers (for example, electrons). The p.d. between two points in such a circuit, also expressed in volts, is the work, in joules, done by these fields on each coulomb that passes from one point to the other. In a pure resistor, all this energy is converted to heat, which leads to the definition:

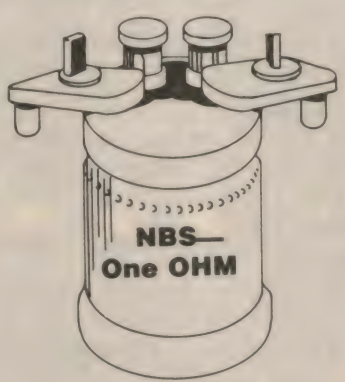
"The volt is the difference of electric potential between two points of a conducting wire carrying a constant current of 1 ampere, when the power dissipated between these points is equal to 1 watt". (1 watt = 1 joule per second).

Resistance: A resistor, as mentioned, is a conductor in which all of the electrical energy is converted to heat. Resistors obey Ohm's law: the current in a resistor is proportional to the p.d. across its ends. The resistance, in ohms, is the number of volts of p.d. needed to produce a current of 1 ampere through the resistor, or:

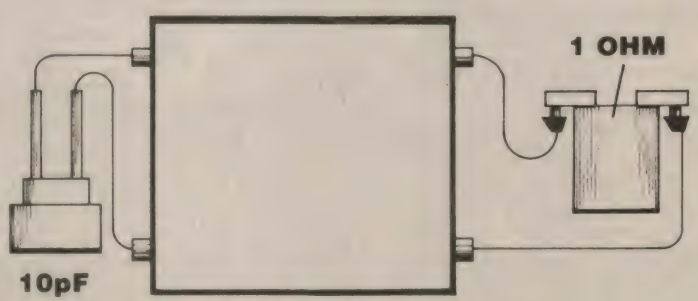
"The ohm is the electric resistance between points of a conductor when a constant potential difference of 1 volt, applied to these points, produces in the conductor a current of 1 ampere, the conductor not being the seat of any electromotive force."

Capacitance: Any pair of electrical conductors separated by a non-conductor is a capacitor. If equal and opposite charges are given to the two conductors, the p.d. between them is found to be proportional to the charge. The number of coulombs required to bring the p.d. up to 1 volt is the capacitance, in farads, of the capacitor. Since capacitance is affected by changes in the position of nearby conductors, precision capacitors are enclosed in a metal envelope or shield (normally connected to a ground) that practically eliminates such changes.

A capacitor can also be characterised by its dynamic behaviour. If we apply to a capacitor an alternating emf, i.e., one that pushes the electrons alternately onto one of the conductors of the capacitor,



NBS 1 ohm reference resistor. Resistance is provided by a length of manganin wire inside a hermetically sealed container. Manganin is an alloy (85 percent copper, 12 percent manganese, 3 percent nickel) whose resistance is very little affected by changes in ambient temperature.



Resistance of a reference resistor is measured with an alternating-current bridge, which compares it with the impedance, at a known frequency, of a capacitor that has been calibrated against the calculable capacitor.

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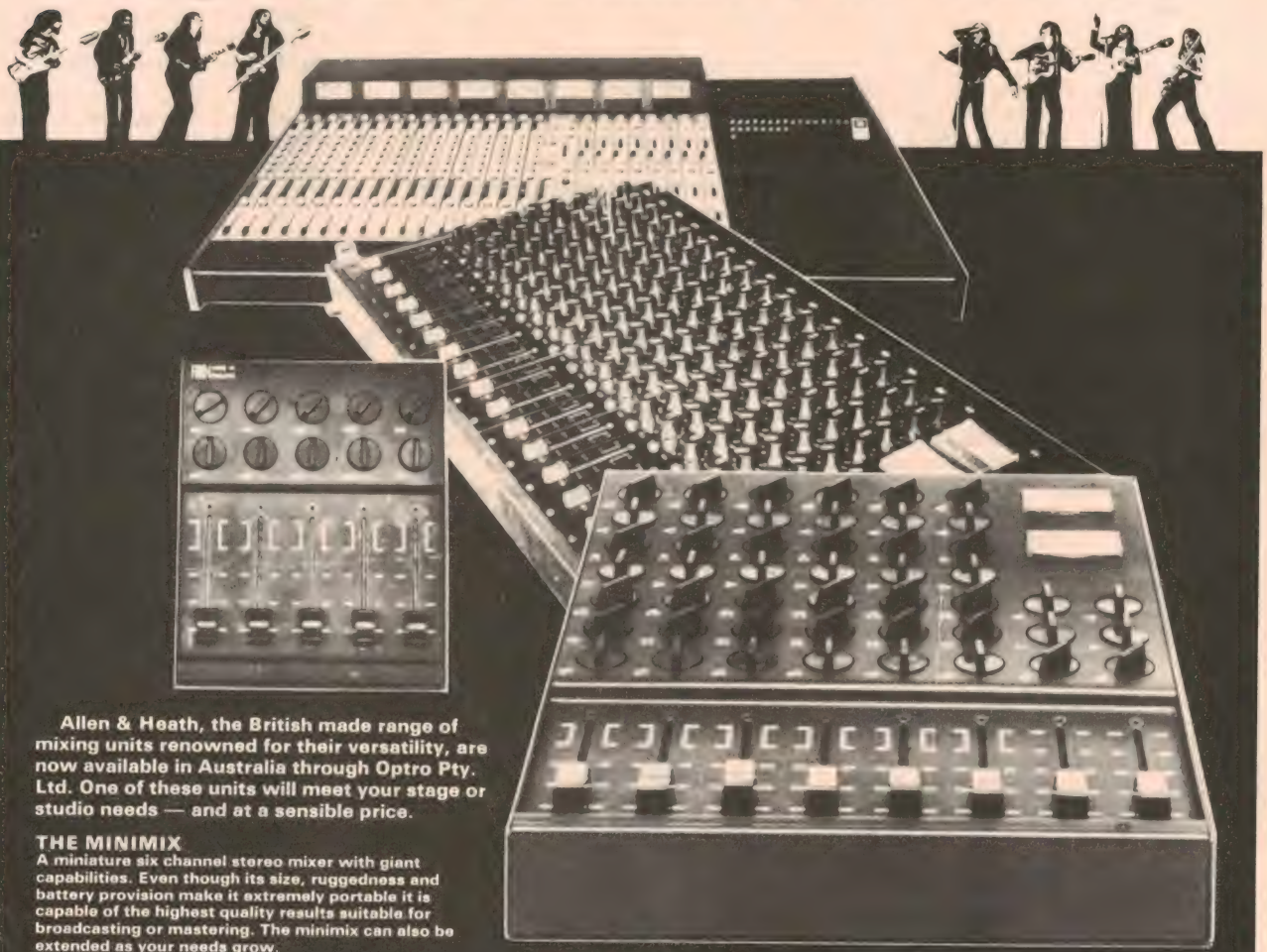

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then onto the other, but changing smoothly according to a sine-wave law, then the current also changes according to a sine-wave law. If the same alternating voltage is applied in turn to several capacitors, the amplitudes (peak values) of the alternating currents produced will be proportional to the capacitances in farads.

For a given capacitor, the current amplitude is proportional to both the voltage amplitude and to the frequency. At a given frequency, the impedance of the capacitor, in ohms, is equal to the voltage amplitude needed to produce a current amplitude of 1 ampere. In a pure capacitance, the current wave leads the voltage wave by one-quarter of a cycle.

Inductance: Inductance has been described as the electrical counterpart of inertia—i.e., as a tendency to resist changes in electric current. The resistance to change takes the form of an induced voltage that pushes electric charges in the direction that minimizes the current change.

Any conductor has inductance, but it is more pronounced when the conductor is in the shape of a coil, and the more turns the higher the inductance. The SI unit of inductance is the henry: a coil has an inductance of 1 henry if a p.d. of 1 volt is induced across its terminals when the current through it changes at the rate of 1 ampere per second. The impedance of an inductor is defined in the same way as for a capacitor and it is also expressed in ohms. But in contrast to a capacitive impedance, the impedance of an inductor increases as the frequency increases and the current wave lags the voltage wave by a quarter cycle.

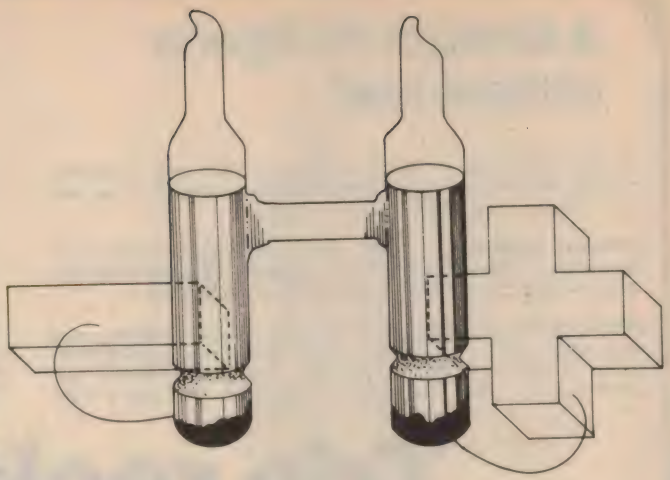
Electrical Standards at NBS

In accordance with the "measurement strategy" outlined above, NBS has constructed standards that embody, as well as the present state-of-the-art permits, the SI units of capacitance, resistance, current and emf/p.d. The SI definitions, some of which are quoted above, relate the electrical units to each other and to the metre, kilogram, and second. The definition of the ampere, for example, relates it to the newton—the force that, when applied to a mass of 1 kilogram, gives it an acceleration of 1 metre per second per second.

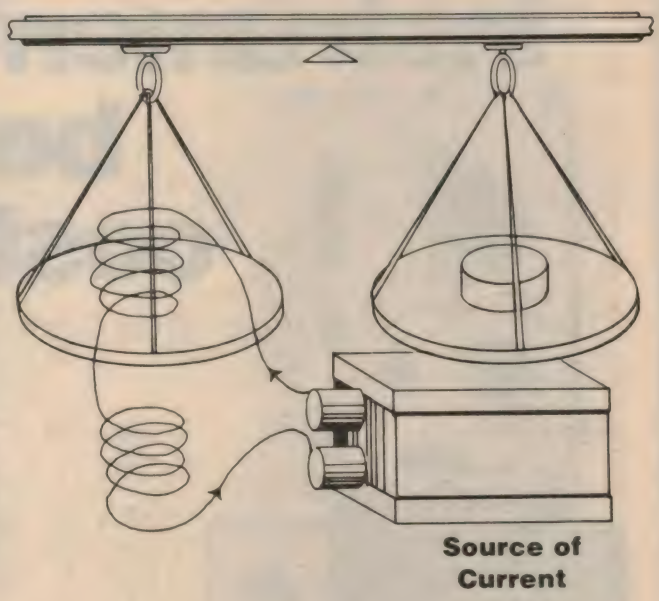
In the following, all uncertainties are expressed in parts per million (ppm) and are based on etimates at the 95 percent confidence level (2 standard deviations).

Capacitance: the farad

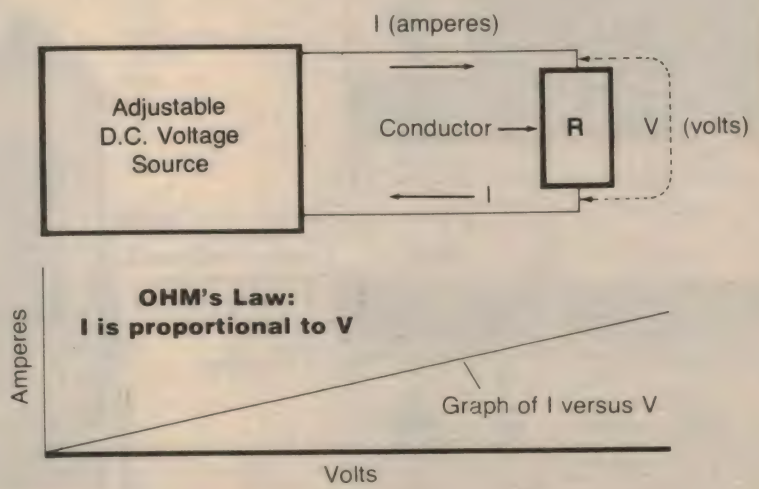
The NBS standard of the farad is a specially designed variable capacitor of the Thompson-Lampard type that has



Standard cell of the saturated cadmium sulphate type. A group of these special batteries forms the working standard of the US legal volt.

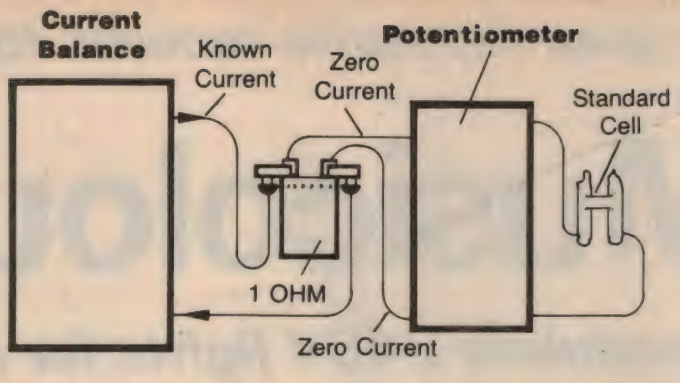


Principle of the current balance: The size of the current, in amperes, is found by measuring the magnetic force between two coils (whose dimensions must also be measured) through which the current flows. The force is determined by balancing it against the weight of a known mass.

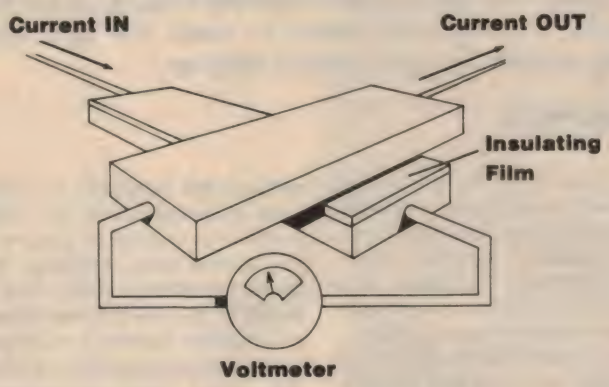


Ohm's Law: The resistance R (ohms) of a conductor = V/I, the voltage across the conductor divided by the current I (amperes) through it. According to Ohm's Law, for many conductors the value of the ratio V/I, and therefore of R, is essentially constant over a usefully wide range of currents and voltages. In this range, I and V are proportional to one another: I = V/R, or V = IR.

US Electrical Standards



The voltage (V) of a standard cell in SI units is determined by comparing it with the voltage across a known resistance (R) through which a known current (I) is flowing. The value of I is calculated by using a current balance.



The AC Josephson effect is used to maintain the constancy of the US legal volt. Microwaves of fixed, accurately known frequency irradiate the junction of two superconductors (the temperature is near absolute zero) separated by a thin nonconducting film. If current is steadily increased from zero, voltage remains zero until a critical current value, when the voltage jumps to ΔV, a small value determined by the microwave frequency. At a somewhat larger current, the voltage rises suddenly to $2\Delta V$, and so on—rising in a series of equal steps. At any point, the voltage is some integer multiple of ΔV. By setting the current so that it is in the range where the voltage is some specified multiple, nV, we always obtain the same voltage to a high degree of precision. This voltage is then compared with the voltages of the NBS standard cells.

been developed over the past 20 years. One can calculate the amount by which its capacitance changes when a grounded metal rod passing through its centre is moved through a distance measured by an interferometer with light from a stabilized laser. The calculated change in capacitance, expressed in farads, depends on the value of the speed of light.

The US legal farad, F_{NBS}, is the average capacitance of a group of 5 reference capacitors, each about 10 picofarads, that have been calibrated against the primary standard. F_{NBS} is believed to be equal to the farad as defined, i.e., to the SI farad, to within 0.02 ppm.

Resistance: the ohm

The US legal ohm is based on the average resistance of 5 reference resistors of close to 1 ohm each, maintained (like all the other national standards) in a carefully stabilized environment. The resistances of these standards were originally determined by comparing them with a calculable inductor. However, preliminary comparisons have now been made with reference capacitors that, in turn, were compared with the calculable capacitor. As a result, the value of the US legal ohm is believed known, in terms of the SI ohm, to within 0.06 ppm

Inductance: the henry

It has not been found necessary to maintain a physical embodiment of the henry, SI unit of inductance. NBS calibrates precision inductors by comparing them, in a special AC bridge, with known capacitors and resistors.

Current: the ampere

The SI definition of the ampere, quoted above, is not, as one soon notices, directly applicable because of its reference to infinite conductors. But when we interpret it in the context of electrical theory we can deduce certain relations that are applicable. We can, for example, work out the relation between the magnetic force between two coils and the current flowing in them (the same current in each coil) when we know the size, shape, number of turns and relative placement of the coils. By measuring the force between two such coils—an instrument for doing this is called a "current balance"—we can calculate the current flowing in them, expressed in the same amperes that are described in the SI definition.

An absolute determination of the ampere by means of a current balance is undertaken by NBS about every 10 years. During each such experiment, which makes the standard current available for about 15 minutes, the value of the current in amperes can be determined to within about 15 ppm.

Electromotive force/potential difference: the volt

During the few minutes the current is flowing in the current balance, it also passes through some known resistances. Using Ohm's law, the potential drop across each resistor can be calculated and can at the same time be used to calibrate the emf of a standard voltage cell.

The accuracy of volt standards calibrated in this way is limited by the uncertainty (15 ppm) in the ampere. Volt standards can, however, be compared with one another to within 0.02 ppm. The US legal volt is based on the average of a set of standard cells (saturated Weston cells) whose voltages are assigned (and monitored about once a month) by an AC Josephson effect device, a precise and linear voltage-to-frequency converter. The US legal volt is believed constant to within 0.08 ppm, though it could conceivably differ from the SI volt by as much as 15 ppm.

To sum up, NBS has highly accurate standards of the farad and ohm. The standards of ampere and volt are somewhat less accurate (1 part in 66,000). However, by means of the Josephson effect, NBS can assure the constancy of its volt standards within extremely narrow limits (± 0.08 ppm). Since the ohm is so accurately known, any improvement in the accuracy of either the ampere or the volt can immediately be transferred to the other (using Ohm's law). The main problem now facing electrical metrologists, therefore, is how to increase the accuracy of the volt or ampere standards, hopefully to match the high level of constancy made possible by the Josephson effect.

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Here is the third Musicolour we have published. Like its predecessors, it is capable of producing an exciting kaleidoscope from your favourite records and tapes. The new model has all the features of the Musicolour II and includes a compressor stage to make the light display less dependent on amplifier volume control settings.

by LEO SIMPSON

These days there must be few people who have not seen, read about or actually built a Musicolour. It was our original circuit, published back in October 1969, which really popularised the device as a party livener and an almost essential appliance for any upcoming pop group.

Since then, it has had widespread applications, both frivolous and serious. We have seen it incorporated into juke boxes and used as an experimental aid for teaching deaf children to speak.

The Musicolour II was published in December 1971 and January 1972. It offered a big increase in sensitivity over the original model in that it required far less power to drive.

However the original model and the Musicolour II, despite their continuing popularity in 1976, suffered from one significant drawback. The control characteristic was narrow and too dependent on the audio level or the setting of the amplifier's volume control.

This meant that most classical music and other music with a large dynamic range was unsuitable for driving the Musicolour, because the lights were "saturated" during loud passages and extinguished in quiet passages.

This often led to the silly situation whereby people would search out the records in their collection which gave the best display. The music content and its appreciation became secondary—the important parameter was its effectiveness as source material for the Musicolour. Which is putting the cart before the horse!

We have obviated this problem in the Musicolour III, by incorporating a simple volume compressor into the circuit. This enables variations in the average input level of more than 30dB without appreciably changing the effectiveness or quality of the display.

Now one can set the controls and listen to any piece of music or any record, without the necessity to adjust the controls to compensate for differing audio levels or a change in volume control setting on the audio amplifier. A convincing test of the effectiveness of the compressor circuit is to drive the new Musicolour with an amplifier having a mute switch which drops the audio output level by 20dB. Hit the switch, and the display does not change appreciably.

The new Musicolour III has updated circuitry and includes a compressor stage.

So that now you can listen to classical music and enjoy the visual effects produced by the Musicolour, without becoming irritated by its lack of control range. And the Musicolour can certainly add a different dimension to the enjoyment of any music. Not that we would ever claim that it could add to the emotive effect. Rather, it produces a certain fascination with the visual display produced by different types of music.

The displays are hard to describe, as we have noted in previous articles; and the description of how the circuit works certainly will not enlighten the reader in this regard. It is better to see one in action or better still, build one yourself! While the new Musicolour is more complicated in its circuit, it is easier to build and safer to troubleshoot and should cost about the same as the superseded model.

Now let us describe in detail how the Musicolour works:

Basically, it splits an incoming audio signal into three frequency bands, referred to as the high, medium and low channels. The signal derived from each channel is used to control a Triac—a semiconductor device which varies the AC power to incandescent lamps. The power supplied to the lamps then becomes proportional to the amplitude of the derived signal.

Since the circuit uses Triacs, the full mains voltage is present in many sections and indeed, depending on how the power point from which it is operated is wired, the whole circuit board will have 240 volts applied to it—no section of the circuit is earthed. This means that the incoming audio signal must be completely isolated —for safety's sake—from the Musicolour circuit.

The method of isolation uses a small mains transformer, 240V to 12.6V, working backwards. That is, the audio is applied to the 12.6 volt winding and is stepped up in the 240V winding. The reason for using a mains transformer instead of a better quality audio type, is that, apart from providing a suitable turns ratio at a modest cost, the transformers specified have very high insulation between windings. They conform to the specifications laid down for transformers used in battery chargers, model train controllers and similar "appliance" applications.

After passing through the step-up isolating transformer, the audio signal is fed

via the sensitivity control to the compressor stage consisting of T1, T2, T3 and T4. T1 and T2 form a direct coupled amplifier with T3 acting as a buffer stage feeding three 4.7k potentiometers in parallel. These pots adjust the signal level applied to the high, medium and low channels.

Diodes D1 and D2 develop a negative DC voltage which is directly proportional to the output signal at the emitter of T3. This negative voltage is used to control the drain-source resistance of FET T4. The drain-source resistance is proportional to the negative DC voltage and has direct control over the gain of T1 and T2 by virtue of its insertion in the feedback loop from the emitter of T3 to the emitter of T1.'

If a large output signal is delivered from the emitter of T3, a proportionally large DC voltage is applied to the gate of T4, which reduces the gain of the whole compressor stage to bring the average audio level back to within narrow limits. The compressor stage can handle about 40dB input range for an output level change of 3dB. It is fairly crude in action, but effective enough for this application.

Frequency splitting for the three channels is accomplished by a combination of active high and low pass filters. These filters consist of a simple second-order filter (double RC network) combined with an emitter follower to act as a buffer stage. Each filter has a gain of slightly less than unity and an attenuation slope beyond the turnover point of 12dB/octave.

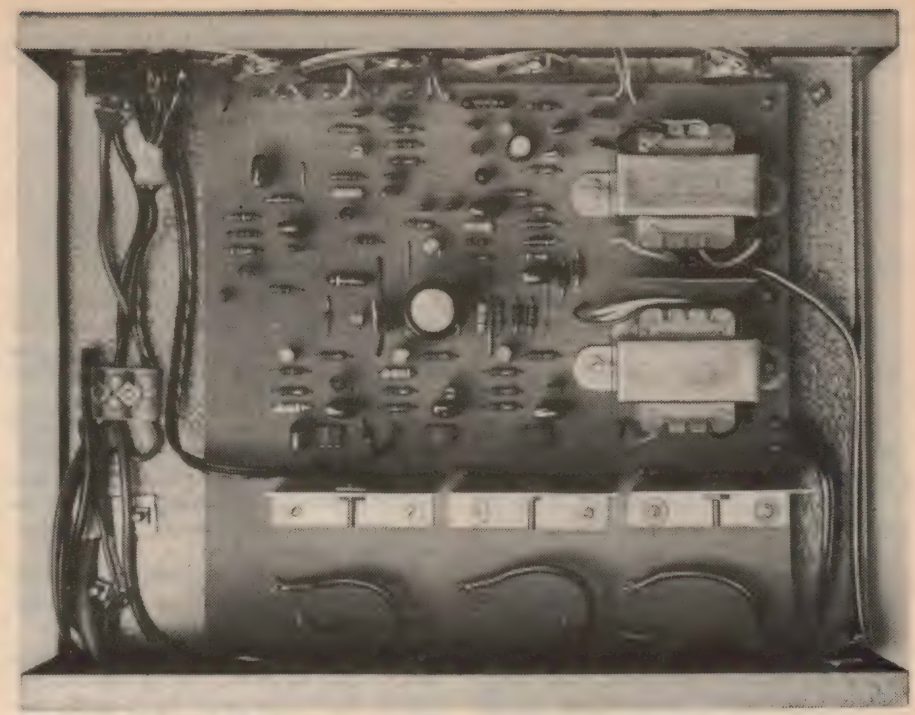
A high pass filter, using T5, is used for the high channel—it passes only those signals above 2kHz. Similarly, a low pass filter using T10 is used for the low channel—it passes only those signals below 300Hz.

The medium channel uses a high pass filter T7 followed by a low pass filter T8. The bandpass of the medium channel is from 300Hz to 2kHz. The frequency allocation of each channel has been selected to give a good visual display with music signals.

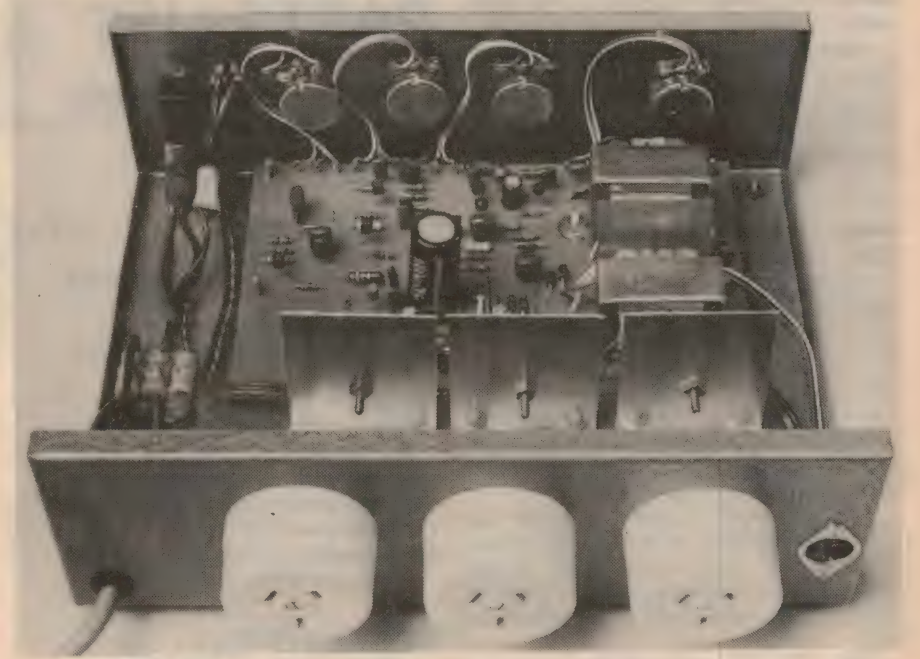
As noted above, the signal from the output of each channel is used to control a Triac and thus the brightness of lamps. To understand how this is achieved, the reader must be familiar with the operation of a Triac.

In essence, the Triac is a bi-directional switch which, after being triggered into conduction, stays "on" until the supply voltage decreases to zero or reverses polarity, when it turns off and can be switched on again. Used with AC, a Triac can be triggered into conduction at any point on either half cycle by a low voltage signal of either polarity applied between the gate electrode and terminal 1 (anode 1). Since the Triac is a bi-directional device it has no anode or cathode as such. The two end terminals are normally referred to as "anode 1" and "anode 2" or "terminal 1" and "terminal 2".

As the Triac is a switching device which is either fully conducting or "off", the only means by which it can provide variable control of power is to use it as a very rapid switch which closes for variable periods of time during each half-cycle of the AC voltage waveform—by adjusting the instant during the half-cycle when it triggers into conduction.



The PCB shown here is slightly different from that shown on page 41.



Note the galvanised steel shield between the two transformers. See text.

The method of triggering used here is to apply a negative DC voltage to the gate of the Triac using a 555 timer IC. The 555 timer is used as a "one-shot" monostable which is reset at the start of every AC half-cycle.

How does the 555 apply a negative DC voltage to the Triac gate? And how does it work as a monostable? Let us consider the high channel alone for the moment.

After resetting at the beginning of each AC half-cycle, the output (pin 3) of the 555 is high, i.e., almost equal to the positive 12V rail. The 0.1uF capacitor at pin 6, 7 is charged by the 100k resistor towards a threshold which is 8V or less. When the threshold is reached, the output at pin 3 drops to a low state, ie, close to OV. Now since terminal T2 of each Triac (and hence the neutral conductor of the AC mains) is connected to the 12V rail, this means that the 555 applies a negative

voltage to the Triac gate via a 100 ohm resistor.

With no signal applied to the high channel, the 8V threshold to which the 0.1uF capacitor must be charged is too high to be reached during a single AC half-cycle. And at the beginning of each half-cycle the 0.1uF capacitor is discharged. So with no audio signal to modify the conditions in the 555 circuit, the Triac is not triggered at all.

In order that the 0.1uF capacitor can charge to the threshold within the AC half-cycle, the threshold must be lowered. This is done by T6, which is connected to pin 5 of the 555 via a 1k resistor. T6 (and T9, T11) is actually a class-B detector. Its base-emitter junction rectifies the audio output of the high channel and lowers the 555 threshold in direct proportion to the audio signal. A large audio signal from the high channel drastically lowers the threshold so that the 0.1uF capacitor can quickly be charged to the threshold and allow the 555 to turn the Triac on early in the half-cycle. This delivers a large amount of power to the lamp load. Similarly, a small audio signal means a small reduction in the threshold and consequently the 555 triggers the Triac late in the half-cycle. This corresponds to a small amount of power delivered to the lamp load.

Thus the 555 together with its associated class-B detector provides a means of controlling the amount of power delivered to the lamps, in direct proportion to the average amplitude of the audio signal.

The 4.7uF capacitor connected to the collector of each class-B detector, T6, T9 and T11, provides filtering of the rectified audio signal.

Resetting of the 555's at the beginning of each AC half-cycle is achieved by applying a rectified 50Hz signal to pins 2 and 4. If this signal was disconnected, the output of each 555 would remain low and the Triacs would conduct continuously. This would mean that the lamps would be at full brilliance. This mode of operation is used in the Standby mode.

When no audio signal is available the Triacs are normally off and the lamps are extinguished. The Standby mode allows the lamps for the Low channel to be lit by inhibiting the reset function for this channel.

The 12V rail is supplied by a transformer of the same type as used for the input coupling transformer. A bridge rectifier rectifies the 12.6VAC and a 10k/33k voltage divider provides the reset function referred to above. The rectified waveform is also fed via diode D7 to a 1000uF/25VW smoothing capacitor. T12 and T13, in conjunction with a 13 volt zener diode, provide a regulated 12V supply.

So let us summarise the operation of the Musicolour III as follows: (1) Audio signal from an amplifier or other source is applied to the isolating transformer; (2) Signal from the transformer is applied to a compressor stage to make it less dependent on overall signal level variations; (3) Signal from the compressor is fed to the frequency-splitting filters to derive three channels, high, medium and low; (4) The signal from each of the three channels is rectified and used to control a 555 connected as a monostable and (5) the 555 monostables control the trigger point of the Triacs. If the Triacs are triggered into conduction early in each AC half cycle, the lamps will be bright and vice versa.

Mains interference suppression components have not been included in the published design. We tried them in the prototype (hence the slightly different PC board in the photographs) but found the results of marginal utility when compared with the cost and effort of making chokes. The problem is compounded by the fact that an improvement on one section of the RF bands can result in increased interference on other bands.

Having described the Musicolour circuit it is now appropriate to devote a few paragraphs on "driving the Musicolour". The input transformer primary presents a load of 250 ohms or more to the driving source. This is the same figure as for the Musicolour II. For the Musicolour II we recommended driving it directly from the headphone socket of a stereo amplifier.

This has proved to be not the most practical suggestion since, on most currently available stereo amplifiers, use of the headphone socket cuts out the loudspeakers. It also prevents users from listening to music via headphones, while using the Musicolour.

We have used a new system of input connection in the Musicolour III. The input socket is a three-pin DIN type, which means that a connection can be made to both loudspeaker outputs of a stereo amplifier. A single wire to pin 2 of the socket provides the common return path to the amplifier—just connect it to one of the earth terminals for the loudspeakers.

If the Musicolour is to be used with a single-channel amplifier, just connect a pair of wires (from pins 1 and 2 of the DIN socket) to the loudspeaker output terminals.

At right is the complete circuit. Note that T4 is shown correctly. It is a symmetrical device so the source and drain can be interchanged.

PARTS LIST

CHASSIS & HARDWARE

1 chassis and cover
1 front panel
4 knobs to suit front panel
2 SPST toggle switches
1 3-pin DIN socket
3 3-pin mains sockets
1 neon bezel with internal limiting resistor
1 50k (log or lin) potentiometer
3 4.7k (log or lin) potentiometers
1 solder lug
4 rubber feet
6 Richco CBS-6N PCB supports
1 three-pin mains plug and three-core mains cord.
1 mains cord clamp and grommet
1 3-way insulated terminal block
Miscellaneous screws, nuts, lockwashers and plastic sleeving.

PCB ASSEMBLY

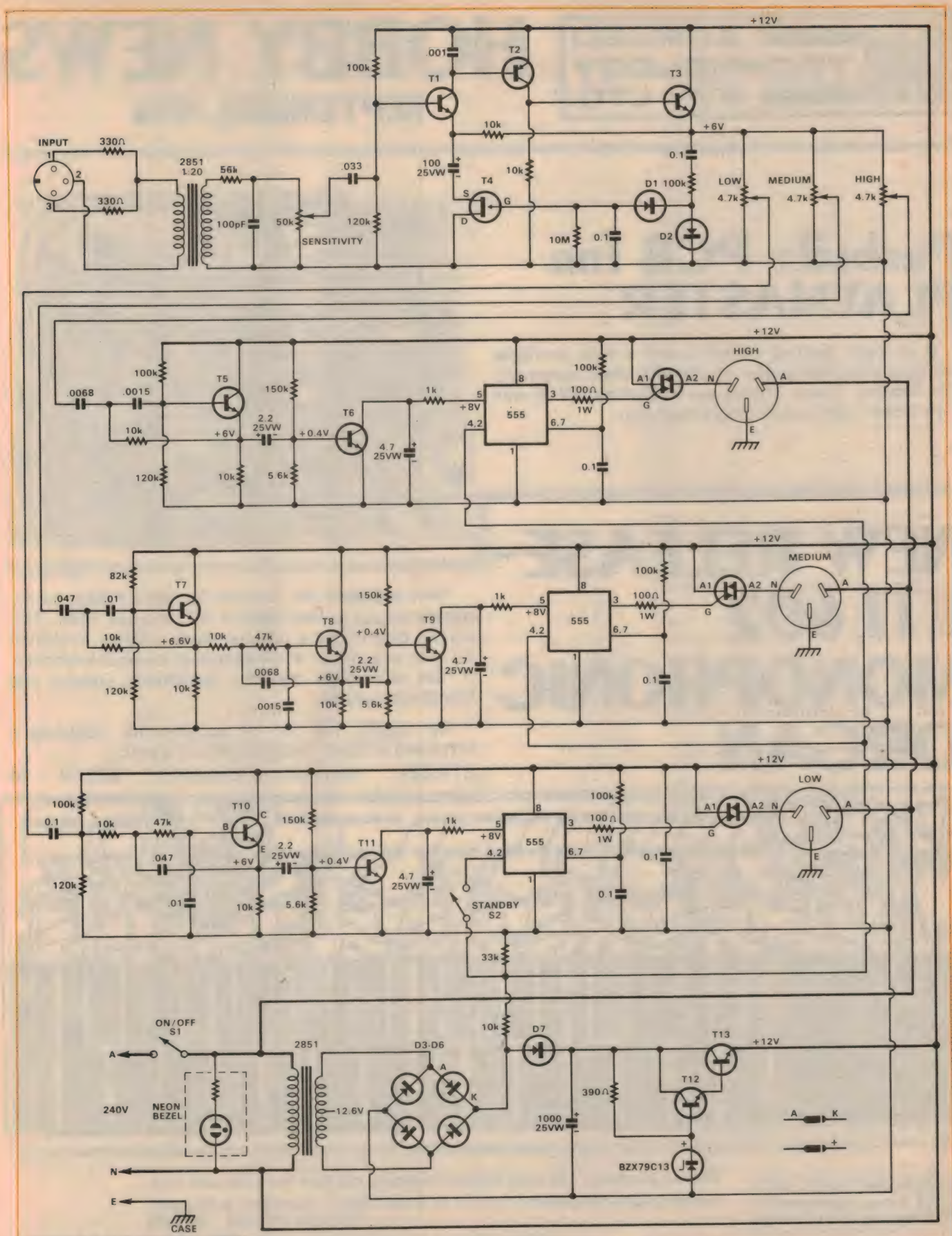
1 PC board, 76pc9, 183 x 167mm
3 aluminium heatsinks (see text)
2 power transformers, Ferguson PF 2851, DSE 2851 or A & R 6474
1 galvanised steel shield (see text)
23 PC stakes

SEMICONDUCTORS
2 1N4148, 1N4001 silicon diodes
5 1N4001, EM401 silicon diodes
1 BZX79/C13 zener diode
1 BD137, TT801, C122B silicon NPN power transistor
10 BC548, BC108, silicon NPN transistors
1 2N5459, 2N5458, 2N5457 field effect transistor
3 555 timer integrated circuits
3 Triacs; any 6-8A 400V type, preferably plastic encapsulated for ease of mounting

CAPACITORS (all PCB types)
1 1000uF/25VW electrolytic
1 100uF/25VW electrolytic
3 4.7uF/25VW electrolytic
3 2.2uF/25VW electrolytic
7 0.1uF metallised polyester (greencap)
3 .047uF metallised polyester
1 .033uF metallised polyester
3 .01uF metallised polyester
2 .0068uF metallised polyester or polystyrene
2 .0015uF metallised polyester or polystyrene
1 .001uF metallised polyester or polystyrene
1 100pF ceramic or polystyrene

RESISTORS (10% tolerance, ¼W, unless otherwise noted)
1 x 10M, 3 x 150k, 4 x 120k, 7 x 100k, 1 x 82k, 1 x 56k, 2 x 47k, 1 x 33k, 11 x 10k, 3 x 5.6k, 3 x 1k, 1 x 390 ohms, 2 x 330 ohms, 2 x 330 ohms ½W, 3 x 100 ohms 1W.

NOTE: Where voltage ratings are not quoted they should be 25V or more. Components with higher ratings may be used provided they are physically compatible.



T1,T3,T5,T6,T7,T8,T9,T10,T11,T12 : BC548,etc.
T2 : BC559,etc.
T4 : 2N5459,2N5458, 2N5457,etc.
T13 : BD137,C122B,TT801,etc.
D1,D2 : 1N4148,1N4001,etc.
D3-D7 : 1N4001, EM401,etc.
TRIACS : ANY 6-8A 400V TYPE

2/PC/-

EA MUSICOLOUR 3

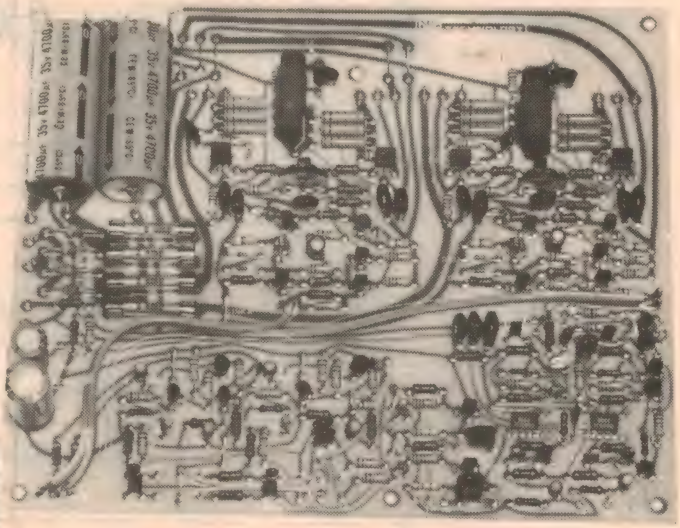
APPLIED TECHNOLOGY PTY. LTD.

HOBBY NEWS

SEPTEMBER, 1976

Prebuilt PCB for PLAYMASTER

A prebuilt printed circuit board is now available for hobbyists who prefer to simplify their construction further. These boards are manufactured in our own factory and tested before despatch.



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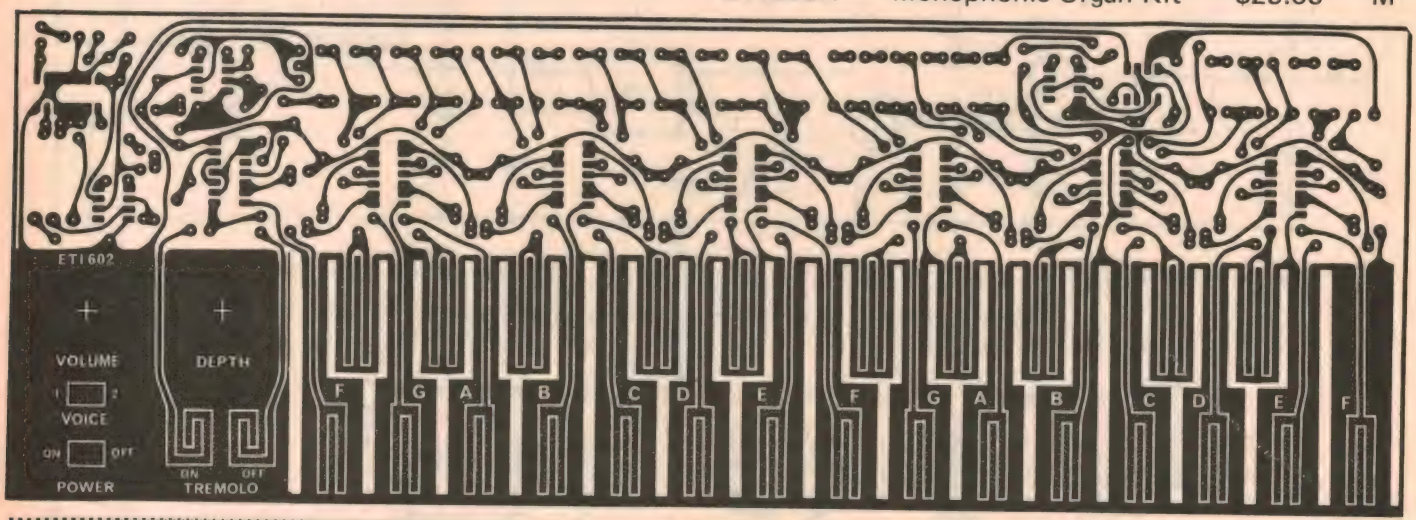

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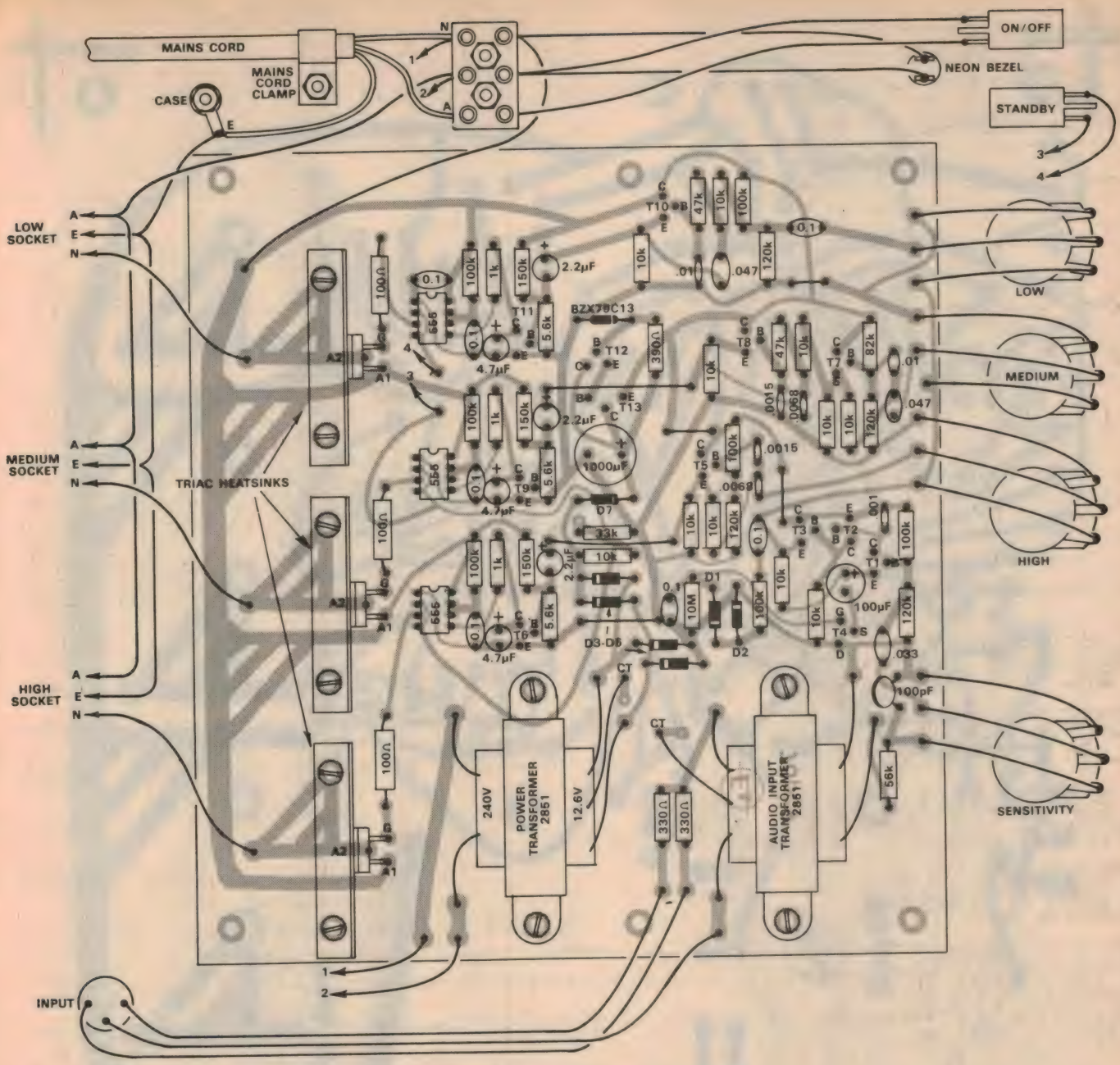


Duplicate the wiring layout shown here to make your Musicolour as safe as possible.

Any amplifier capable of about 100 milliwatts or more can drive the Musicolour, directly from its loudspeaker output terminals.

Each channel of the Musicolour can drive up to 1000 watts of incandescent lamp load. Each individual lamp should not have a rating of more than 150 watts. These maximum ratings are quoted to protect the Triacs against surges and arc-over in lamps.

Note that fluorescent lamp loads must not be used. Note also that, although each channel can handle up to 1000 watts, the total load should not exceed 2400 watts. This limitation is set by the 10-amp rating of most mains power points.

The Musicolour is mounted on a U-shaped chassis measuring approximately 245 x 80 x 200mm (W x H x D), fitted with a wrap-over cover. These are the same overall dimensions as for the Musicolour II. In fact, the new PC board fits into the old metalwork with space to spare. We imagine that many readers will update their old Musicolour to the new circuit.

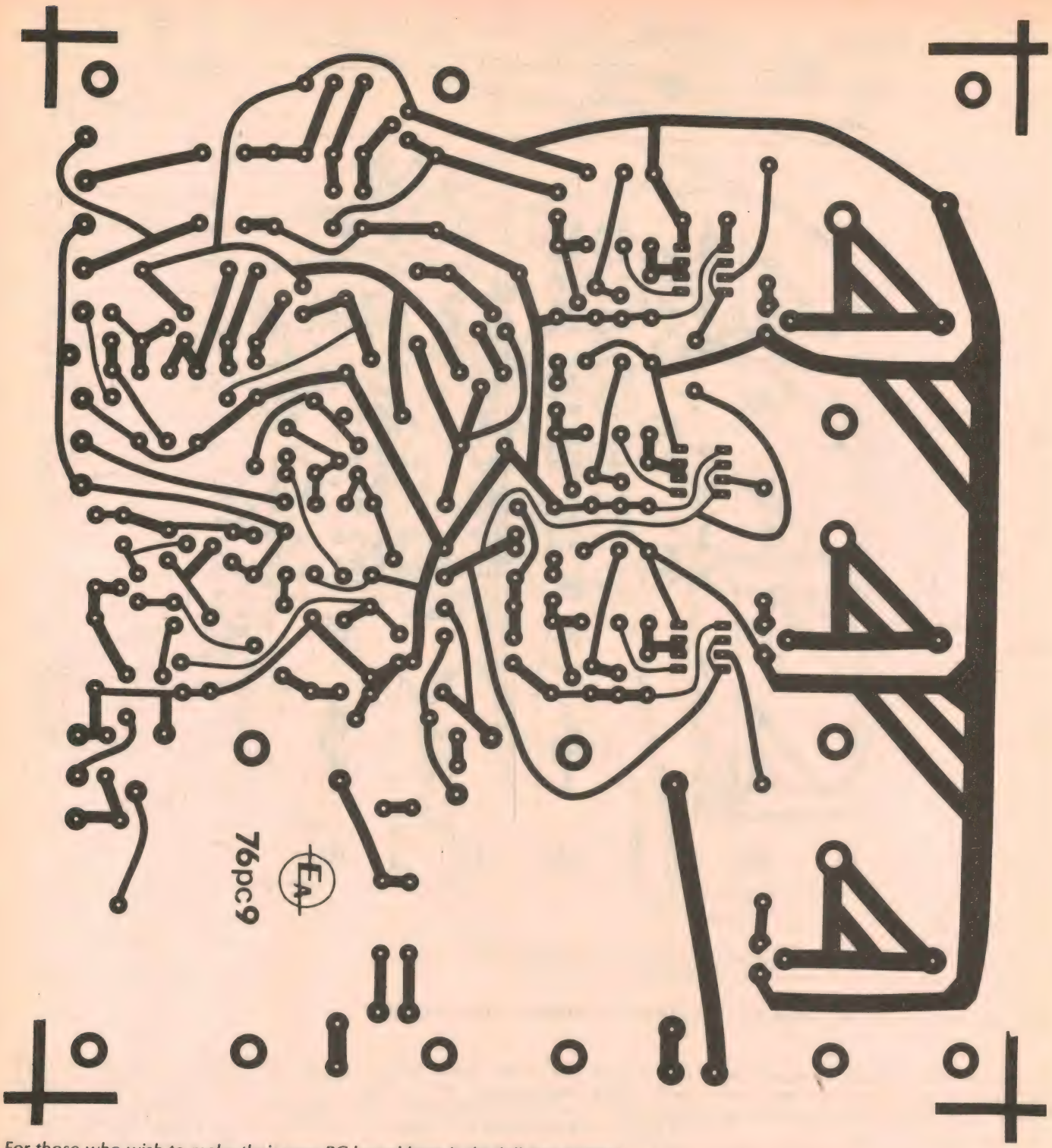
Controls on the front panel comprise the four knobs for Sensitivity, High, Medium and Low, two switches for Power and Standby and a neon pilot light. On the rear panel, there are three 3-pin mains sockets for the load of each channel, plus the 3-pin DIN input socket.

All the circuit components, with the exception of the potentiometers and switches, are mounted on a PC board measuring approximately 183 x 167mm. Code of the PCB is 76pc9.

Each Triac has a separate heatsink, which is mounted on the board. With the heatsinks specified, the 1000W/channel rating holds up to ambient temperatures of 40 degrees C. If ambient temperatures rise above this, the load should be reduced, eg, if the temperature rises to 45 degrees C, the load per channel should be reduced to 800 watts.

Just about any Triac with a rating of 6 or 8 amps and 400 volts can be used, although the plastic encapsulated types are more convenient to install. The leads have to be bent slightly to match the PC board.

We hesitate to recommend the use of higher rated Triacs. For one reason, they may have inadequate sensitivity. And even if higher rated Triacs are used, we do not recommend that the load rating be increased.



For those who wish to make their own PC board here is the full size pattern.

Each Triac heatsink is made from a piece of 20-gauge aluminium, 70mm long by 50mm wide, bent so that it has a 10mm flange. The heatsink should be drilled to suit the Triacs used.

Both transformers are the Ferguson PF 2851, the DSE 2851 (as supplied by Dick Smith Electronics) or the A&R 6474. Other types should not be used unless they are exact equivalents. The transformers should be spaced off the PC board by the thickness of two washers. This is to avoid undue stress to the board when the transformer mounting screws are tightened.

We found it necessary to shield the input coupling transformer from the power transformer. This is achieved with a piece of 24-gauge galvanized steel (not aluminium) 40mm wide and 70mm long, bent so that it is secured under the core of the power transformer.

Even with this shield, some hash and hum is coupled into the input-coupling transformer. This has the following result: With no audio signal applied and all controls at maximum, there is a tendency for the high and low lamps to light. The unit is sensing its own mains-generated hash. As soon as a signal is applied, the compressor acts to reduce the system gain and a normal display is produced. The only complete cure for this problem is to mount the power transformer off the board, away from the input transformer.

We think that most readers will take the simpler approach, as we have, and simply not use the unit with all controls at maximum.

A suggested order of construction is as follows: First mount all the small components, such as resistors, capacitors, wire links and diodes. Next mount the transformers and heatsinks. The heatsinks will always be "live" at 240VAC, whether or not an insulated case Triac is used. Connections are provided on the PC board for the centre-taps of the transformer low voltage windings. Use lockwashers under all mounting screws.

Now mount the semiconductors. Ensure that they are correctly inserted. Damage will occur to the 555's if they are incorrectly soldered in and power applied. A similar warning applies to the other semiconductors.

A special note is required on the regulator power transistor, T13. While we have tabulated several types on the circuit diagram, the type we actually used was a C122B. This is a power transistor of Japanese manufacture commonly available from parts outlets, at least in Sydney. Do not confuse it with the General Electric 200V SCR of the same type number! This is a trap, and you have been warned!

PC stakes are recommended and any type may be used provided they are a tight fit in the PC board holes before soldering. These allow connections to the PCB to be quickly broken to remove the board from chassis.

Having checked the board carefully for wiring errors, components may be installed in the chassis. Rubber feet are secured with a screw and nut, the nut being held in the foot itself.

The mains cord is passed through a grommeted hole in the rear of the chassis and anchored by a clamp. The active and neutral wires are terminated in an insulated terminal block. The earth wire is soldered to a lug which is bolted to the chassis. The earth wire should be left with a loop of slack so that, if the cord is strained to the limit, the earth wire is the last to break.

Proper earthing of the chassis is the most essential step in the construction of the Musicolour. If it is not properly earthed a wiring mistake or component failure could make the chassis "live" and lethal!

Care is particularly necessary where the equipment is to be used in a public situation, in association with a public address system, musical instrument amplifiers, coloured spotlights, festoon lighting, etc. In these circumstances, the Musicolour unit itself should be checked by a qualified electrician, along with the lighting fixtures to be connected to it.

Note that the mains wiring to the output socket and the mains cord and plug and the mains switch, should have a rating to suit the total load the Musicolour is intended to drive. If 2400W is the intended load, 10-amp wiring must be provided, particularly the mains cord and plug.

Cut all the potentiometer shafts to a length to suit the knobs. Mount all the pots and switches but leave the front panel off at this stage to avoid scratching it. It can be installed after the unit is fully operational. Before soldering wires to the mains switch and neon bezel, push a length of plastic sleeving over the wires and after soldering, push the sleeving over the terminals.

The PC board can now be dropped into place in the chassis and mounted on "Richco" insulating plastic supports. Both board and chassis should be drilled to suit these supports. Six are required. Now make all connections exactly as in the wiring diagram.

Before the unit is connected to the display lamps and power applied, several checks should be made. First and most important, that there is a direct connection between the earth pin of the mains plug and the chassis. Also, check that there is high resistance (eg, several megohms) between the heatsinks and the neutral line of the mains. There should be high resistance between both sides of the mains and the chassis. These checks should be made with a multimeter.

Now switch the unit on, with all lamps connected. The lamps should flash once at switch on and then go out. Switching to Standby should light the Low channel lamp(s).

In operation, it will be found that there is an optimum setting for the controls to obtain the best light display. This is in spite of the internal compressor. If controls are set too high, the lamps will tend to remain alight and vice versa.

If the Musicolour does not function first time, here are a few points on trouble-shooting. Remember, though, that this procedure can be hazardous because the full mains voltage is present in the circuit. If you do not have a multimeter and/or do not feel confident about your ability to cure a fault in the device, leave it strictly alone. Take it, along with this article, to a competent serviceman.

The first step in trouble-shooting is to measure all the DC voltages shown on the circuit. These should be taken with no audio input signal applied to the input. Before making measurements, disconnect the AC mains neutral to the PC board at the insulated terminal block. Disconnect the lamp cords from the three output sockets. This renders the Musicolour safer to work as the mains is removed from all the circuitry with the exception of the power transformer primary, on-off switch and the neon bezel. Mains connections to these components should be fitted with plastic sleeving, as noted above.

DC voltage measurements shown on the circuit should be taken as a guide, not gospel. If the readings on the PC board are within about 10% of those on the circuit, there is no need to worry. These measurements should pinpoint most of the problems in the low voltage circuitry, with the exception of faults in the 555.

With no signal applied, voltage at pin 3 of the 555 should be close to 12V. Now short the collector of T6 (or T9, T11) to its emitter. This should drop the voltage at pin 3 to less than 2V. If this occurs, the 555 is okay. If the same result is achieved by shorting the base of T6 (or T9, T11) to its collector, then T6 is okay.

If the fault appears to be in a Triac it can be checked in the following way. Disconnect the 100-ohm gate resistor from the associated 555. Now reconnect the mains neutral and mains lamps. Turn on. If the lamp is alight, carefully short the gate of the appropriate Triac to its A1 terminal; if the lamp is still alight, the Triac is shot.

If the lamp will not normally light, the Triac should be checked in the following way. Disconnect the gate electrode as before and connect it to A2 via a 1k resistor. The lamp should now light. If not, replace the Triac.

Remember that mains voltage is applied to all the circuit when the whole unit is functioning. Use absolute care at all times. Preferably, do not work alone but with a companion who can check your actions. You cannot be too careful. Dead readers do not buy "Electronics Australia" (at least as far as we know!), so that for our sake as well as your own, take care.

To conclude, here are a few ideas for making a light display:

Most of the displays can be built around 25-watt or 40-watt coloured globes. These are available in red, yellow, green and blue. The blue lamp will not appear nearly as bright as the red and yellow types. This is because the eye is less sensitive to the blue end of the spectrum, and tungsten filaments emit most of their light in the red and yellow region of the spectrum. This means the blue filter stops most of the light. In general, the power needed for the blue lamps will be two or three times that for red and yellow lamps.

The display lamps should not be viewed directly. The basic materials needed to make interesting patterns are crinkled aluminium foil and frosted, fluted or patterned glass.

The simplest display is to mount three or more coloured lamps on a board and place them behind a stereo cabinet so that they light the wall behind it.

Another idea is to mount a number of lamps along a board, place frosted glass in front of them, and mount the whole display on top of the stereogram, organ or in the "interest point" in the room. Lights can be placed inside a cabinet, with crinkled aluminium foil behind them, and frosted glass in front.

For higher power displays, coloured spotlights will be required. Coloured spotlights are marketed by Philips and available from trade houses which specialise in lighting. The lamps are in the Philips Comptalux range and are available in red, yellow, green and blue.

Many interesting displays could be obtained with these spot lamps aimed against walls, using beam splitting mirrors and rotating mirror balls. Your imagination is the only limit.

Check your car's exhaust emission with this

Exhaust Gas Analyser

A major cost incursion facing today's motorist is the cost of petrol. A badly tuned engine will not only waste petrol and hard-earned dollars, but will also result in increased exhaust pollution. This build-it-yourself exhaust gas analyser from Heathkit will provide a quick check on engine fuel mixture, so ensuring that you do not waste precious fuel nor contribute unnecessarily to air pollution.

by GREG SWAIN

On July 1st this year Australian Design Rule 27A (ADR27A), the toughest motor vehicle anti-pollution legislation ever enacted, came into force. The new rule sets the maximum permissible levels of pollutants in an exhaust system, and is the latest in a series of anti-pollution laws introduced in recent years.

Although the new rule applies only to new cars made after July 1st, we should all be doing our bit to control air pollution. Those of us with pre-ADR27A cars can play our part by keeping them in good tune. By so doing, we will not only cut down on exhaust pollution, but will also save money due to improved fuel economy.

It was with these thoughts in mind that our attention was recently focused on the Heathkit Model CI-1080 Exhaust Gas Analyser. As we shall explain below, an exhaust gas analyser is an invaluable piece of diagnostic test equipment which enables a quick check to be made on engine fuel mixture and exhaust emission over a variety of operating conditions.

Physically, the Model CI-1080 Exhaust Gas Analyser consists of a meter unit and a sensor, which operate from either a 6V or a 12V car battery. The meter is designed to hang on a partially open window or set on a convenient surface. The sensor is used near the tailpipe and has a removable stainless steel flexible probe tube. This all stores neatly in a durable plastic case.

In a nutshell, the Model CI-1080 is an instrument that will indicate the relative combustion efficiency, air-fuel ratio (AFR) and percent of carbon monoxide of typical four-cycle engine exhaust gases. These values are indicative of the interaction of carburettor and ignition settings, and also provide a good way to check emission control systems.

Before proceeding further, however, it may be as well to point out that this unit should not be used to adjust exhaust emissions from vehicles designed to meet ADR27A. The unit is simply not accurate enough for that purpose. In fact, claimed accuracy is only in the order of 1 unit for air-fuel ratio, and about 3% in terms of CO content.

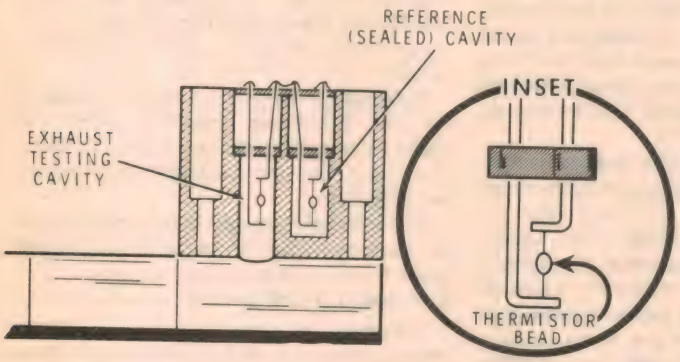


Fig.1: this diagram shows the general construction of the sensor element. Two thermistor beads are contained in the element, one sealed in an air chamber, the other in a chamber with a baffled port.

For example, under ADR27A the maximum allowable CO content in an exhaust emission must not exceed 4.5% at idling speed. If we now consider that the unit described here is only accurate to 3% CO, it may be readily appreciated why it should not be used for adjustment purposes. A significant error could otherwise result.

Let's now consider the operating principle of the Model CI-1080.

Basically, the unit operates by comparing the thermal conductivity of the exhaust gas with that of air. The relative values are then indicated on a large meter.

To explain further, operation of the unit is based on two physical factors:

- The thermal conductivity of exhaust gas varies from that of air; and
- the electrical resistance of some materials varies according to temperature.

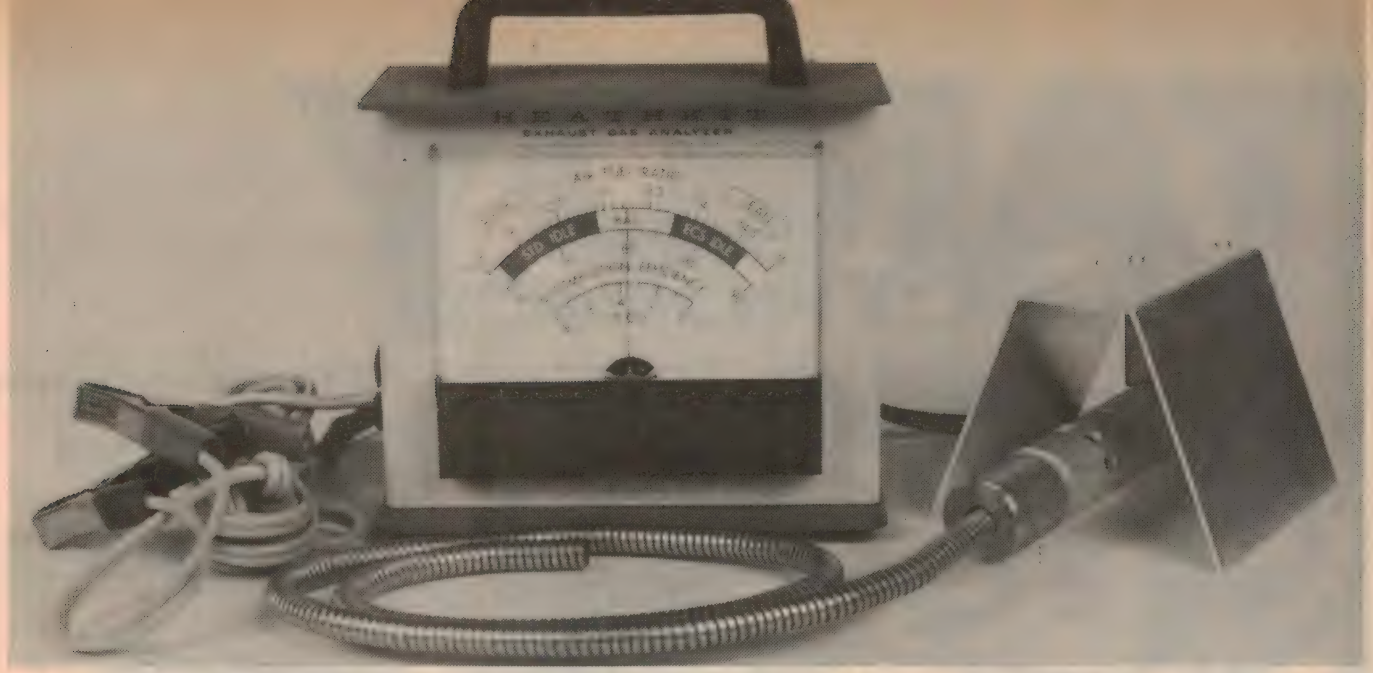
In the case of the CI-1080 exhaust gas analyser, two thermistor beads are used in a sensor probe. These thermistor beads have a large negative temperature coefficient of resistance, meaning that an increase in device temperature leads to a corresponding rapid drop in resistance.

In practice, an electric current is passed through the thermistors, raising their temperatures to around the 150°C mark and dropping the resistance of each from 2000 ohms at room temperature to about 100 ohms. The actual resistance of each thermistor will depend on the temperature, which in turn depends on the conduction of heat from the thermistor to the air or gas that surrounds it.

Refer now to the circuit diagram. The two thermistor beads are matched at a specific current and dissipation and are connected in opposite sides of a bridge circuit. One bead is sealed in a cast aluminium chamber, while the other is placed in an adjacent chamber that has a baffled port to collect exhaust gases (Fig. 1).

In operation, the bridge is first balanced with both thermistors exposed to air. Then the unsealed thermistor is exposed to exhaust gas. The thermal conductivity of the gas alters the temperature of the thermistor (and therefore its resistance), which unbalances the bridge proportionately. The appropriate reading is then indicated on the meter.

Power supply circuitry consists of diode D1 for reverse voltage protection, together with the nonlinear resistance of lamp L1 and the 4.7V zener diode D2 for



voltage regulation. The unit is designed to operate from either a 6V or a 12V battery. Resistors R1, R2 and the meter shunt resistor R4 limit the current into the bridge.

Calibration resistor R3 is switched in series with the meter during the calibration procedure, as detailed in the assembly manual. R2 is then adjusted to give a full-scale meter reading, representing a current of 20mA into the bridge. Resistors R5, R6 and R7, in company with the two sensor thermistors, go to make up the meter bridge. R7 is used to balance the meter with both thermistors exposed to air.

Now, what of the kit itself, as a do-it-yourself project for the enthusiast?

Heathkit are renowned the world over for the thorough presentation of their kits, and this one is certainly no exception. It arrived well packaged, literally complete to the last nut and bolt, and accompanied by the usual step by step assembly manual. Also included was a separate manual describing the basics of kit building in some detail, and evidently aimed at the novice.

As with most Heathkit projects, the assembly instructions are so detailed that even a raw beginner could complete this kit, provided of course that he had some knowledge of soldering techniques and could successfully wield a screwdriver! In our case, the unit took only a few hours of work, and worked from switch-on.

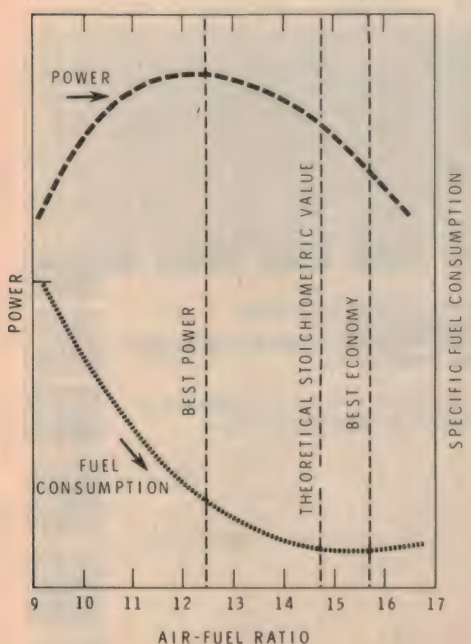


Fig.2: graph showing the relationship between performance (power) and economy over a range of air-fuel ratios.

Operational procedure is also well detailed in the assembly manual, and a summary is given below:

- warm up the engine to its normal operating temperature and allow to idle with the transmission in neutral;
- connect the meter to the battery and use the balance control to adjust the needle to the BAL point;
- set the sensor near the end of the exhaust pipe and insert the end of the flexible tube 15-30cm into the pipe;
- after the meter stabilises, note the meter indication of the relative air-fuel ratio.

Now what exactly is an exhaust gas analyser used for? Surprisingly, and in spite of detailed assembly and operating instructions, Heathkit give little indication. The assembly manual simply states that the unit "is designed to be used on four-cycle engines after a tune-up to determine exhaust emission from typical commercial gasolines." While this statement is true, other uses of the unit can certainly be elaborated on.

Firstly, an exhaust gas analyser can be used to check engine idle mixture, a statement that must seem somewhat paradoxical in view of the fact that on cars made after June 1974 the idle mixture screw is sealed to prevent adjustment by the home mechanic. Either that, or only a very limited range of adjustment is available.

To explain, it must be emphasised that the CI-1080 is used purely as a diagnostic tool. Having diagnosed a fault condition (eg idle mixture too rich), the vehicle should be taken to an authorised service centre for repairs. The idle mixture screw should be resealed after adjustment.

However, checking engine mixture at idle speed is not the only potential use of an exhaust gas analyser. The CI-1080 can also be adapted to test a vehicle under actual road conditions (Heathkit recommend the use of a dynamometer), so that the engine can be tested under load. This will require a little ingenuity on the part of the user, as the unit is not physically intended for use in this role.

A suitable arrangement would probably be to securely tie or tape the exhaust sensor to the car bumper bar, and run the sensor lead to the meter through a rear window. The window can then be clamped against the lead to secure it in position. Power for the unit would most conveniently be derived from a cigarette lighter adapter.

Do not place the sensor unit in the boot for road testing. Exhaust gases could seep back into the cabin. Carbon monoxide is colourless, odourless, and potentially lethal!

Again, we don't suggest that you attempt to drive and take readings at the same time. Take along an observer to take readings for you.

In most cases, modern cars with some form of emission control should produce readings on the lean side for both idle and cruising speeds. Older cars may give readings on the rich side at idle, but at cruising speeds the pointer should swing to the lean side. Quick acceleration bursts should be indicated by a brief rich reading.

A rich reading should also result if the engine is placed under a load condition e.g., accelerating up a hill. If your car

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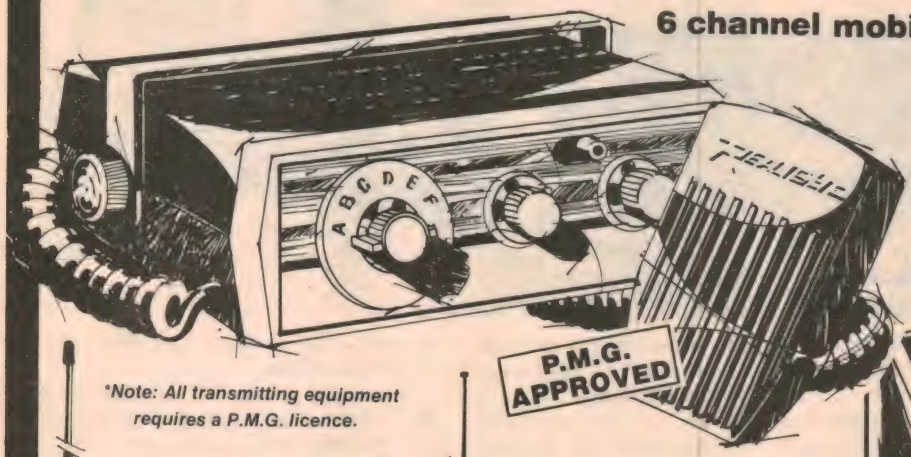

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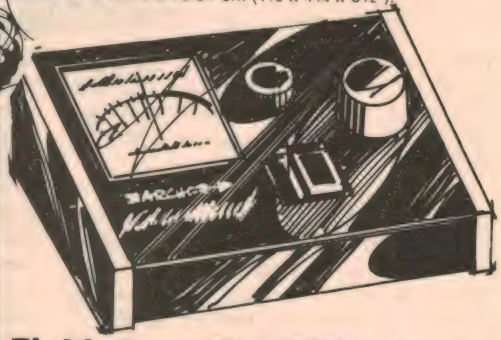

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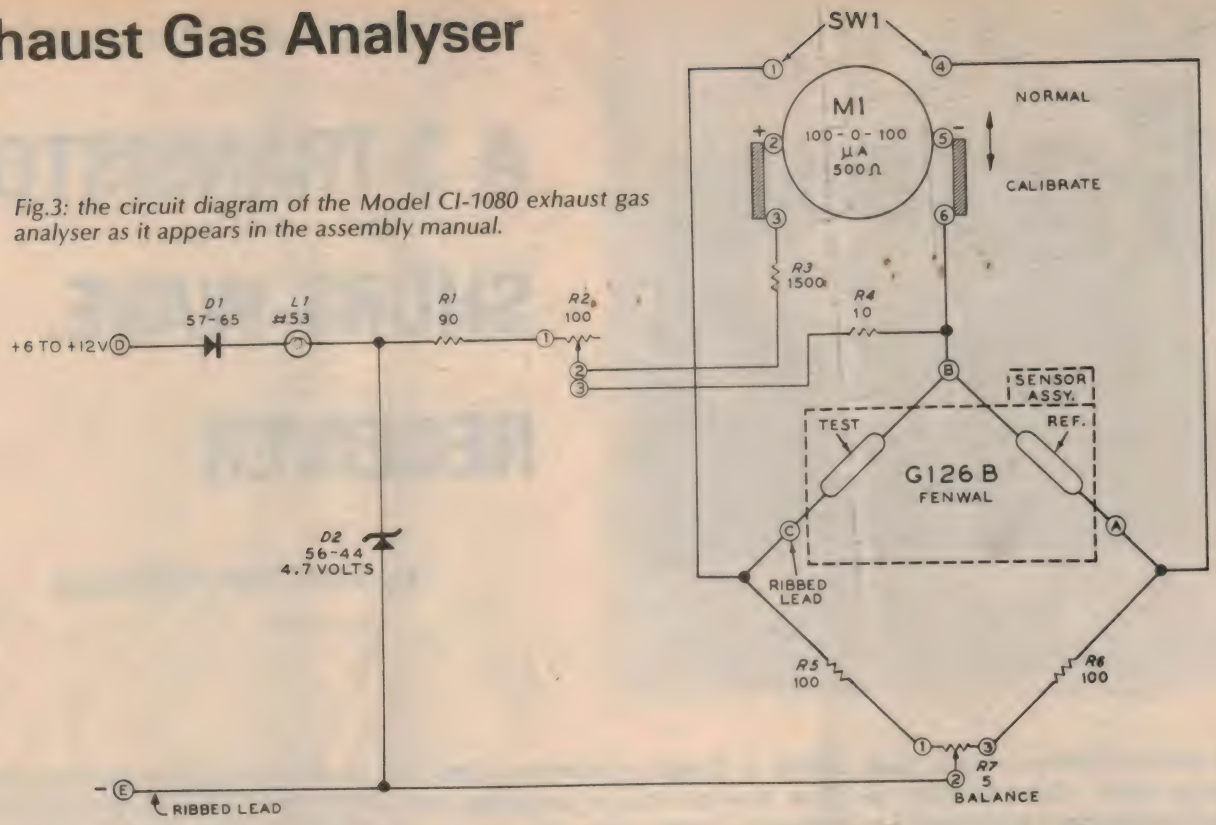


Fig.3: the circuit diagram of the Model CI-1080 exhaust gas analyser as it appears in the assembly manual.

indicates differently from these conditions, then the vehicle should be serviced. For example, if readings stay on the lean side when the engine is subjected to hard acceleration, then this indicates that the mixture is excessively lean; and a lean mixture could lead to burnt valves due to excessively high temperatures in the combustion chamber.

Conversely, if the readings obtained are consistently on the rich side then you are wasting fuel and polluting the atmosphere. And with the cost of petrol these days, wasted fuel can add up to quite a few dollars over a period of time.

In all cases, actual engine adjustments (e.g., to the carburettor or to the ignition system) should be carried out according to the engine manufacturer's specifications and methods.

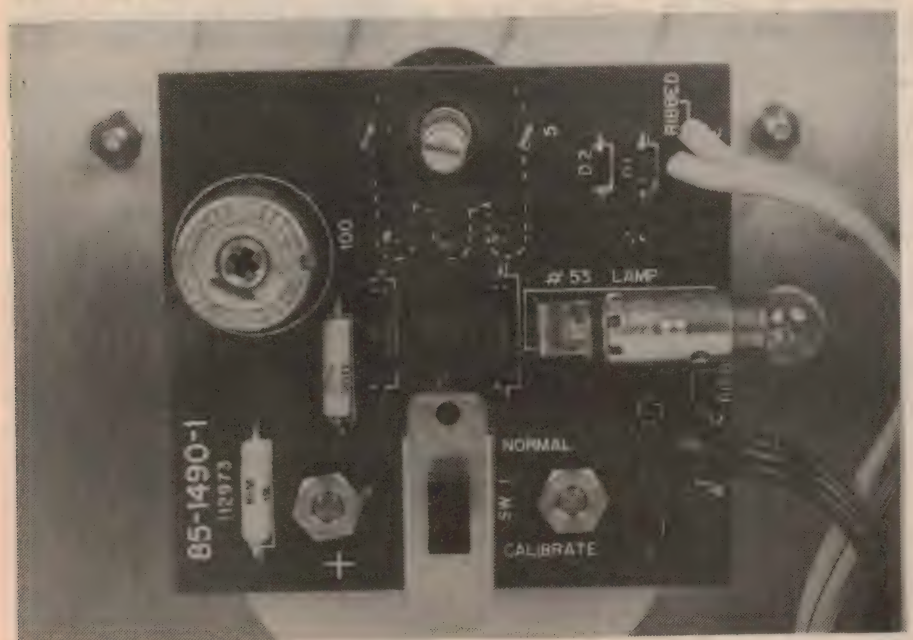
Under normal cruise conditions air-fuel ratio should be of the order of 14:1 or better. If the vehicle is pushed hard at a high speed, this value may drop to somewhere around the 12:9 mark, but should not get too much below this figure.

Note that the analyser should not be used on diesel engines, nor should it be used if you have added solvents or if the engine burns oil to a noticeable degree. Such emissions may coat the sensor and destroy its accuracy. It should also be noted that erroneous readings may result if the exhaust system is leaky.

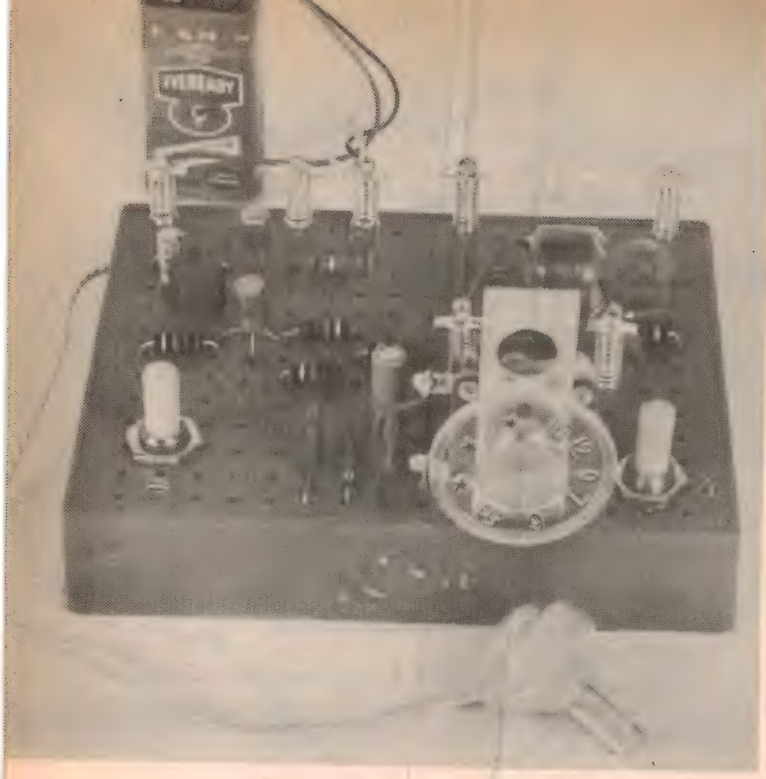
And there you have it—a simple unit that will provide a quick diagnostic check on the operating condition of your car's engine. The one drawback is the cost which, at around the $114.00 mark, is not cheap. Countering this is the high standard of the finished project (as with all Heathkit projects), and the experience you gain by building up the unit yourself.

The Heath Company is represented in Australia by Warburton Franki Pty Ltd, who have branch offices in all state capitals and in Wellington NZ. Readers interested in the Model CI-1080 Exhaust Gas Analyser should either write to The Heath Centre, 220 Park St, South Melbourne, Vic 3205, or ring one of the following numbers: Sydney 648 1711, Melbourne 699 4999, Brisbane 527 255, Adelaide 356 7333, Perth 657 000, Hobart 231 841, Wellington (NZ) 69 8272.

Finally, we will repeat an earlier note of warning. Never make tests on an engine without making absolutely certain that there is adequate ventilation. Carbon monoxide gas is extremely dangerous, and potentially lethal.



This internal view shows the essential simplicity of the completed instrument.



Build this simple kit project:

A 3-TRANSISTOR SHORT WAVE RECEIVER

by WALTER NEVILLE

Why would anyone, these days, want to build a primitive little 3-transistor radio when, for half the price, one can buy a complete commercial 6-transistor superhet? The answer is simple enough: you're not buying seven dollars worth of radio at all—you're buying seven dollars worth of diversion and experience!

The availability of cheap, massed produced radios is unfortunate in one respect, in that it deters beginners from trying to build simple radios of their own. However, the fact remains that, if you want to gain experience with electronic bits and pieces, and you're prepared to commit a few dollars to that end, you may gain more pleasure from an elementary receiver than from many other electronic gadgets that you might think of.

These thoughts were prompted by a simple 3-transistor kit included among those available from Tandy Electronics stores throughout Australia. Designated as a "3 Transistor Short-wave Radio Kit" No 28-110, it sells for $6.95. It is virtually complete, requiring only a 9V battery as an extra, plus an aerial and possibly an earth.

The intention is that the components be assembled on the moulded dish in which they are packaged, the dish having a pattern of numbered holes which key in with the assembly instructions. The whole thing can be assembled on a small table, conceivably with a minimum of tools, but the intention obviously is to encourage the would-be constructor to buy some tools for future use, together with a small soldering iron.

Packaged with the kit is a sheet of construction hints, mentioning tools, identifying typical components and giving instructions about assembly and soldering. A second 6-page leaflet sets out step-by-step instructions for assembling the particular project, and getting it into operation, while a couple of drop-in addenda alert the builder to possible substitute parts.

While the simplest, and probably the cheapest way to acquire all the necessary parts "from scratch", would be to buy the Tandy kit, it would be possible to build an equivalent receiver from components bought separately or recovered from the oddment box or a discarded transistor receiver. It could be assembled on a scrap of particle board, without thought of appearance, or it could be "prettied up" with a more pretentious capacitor and tuning dial, and plug-in coils.

Here a word of caution may be appropriate. A more pretentious tuning capacitor and dial, and carefully finished coils will certainly make it easier to tune the receiver and to re-locate particular stations. However, the basic performance will not be affected all that much because the set will remain what it is—a simple little 3-transistor receiver with strictly limited gain and a strictly limited sound level from the earphone. Physical embellishment would nevertheless confer its own rewards: a better looking project and experience in working to better mechanical standards.

While the literature accompanying the Tandy kit describes all the necessary steps to construct the receiver, virtually nothing is said about the design itself—how it really works. Accordingly, we have redrawn the circuit in a more familiar style and will explain its operation on a stage-by-stage basis. The explanation should assist those working from the original kit, but it will also be a guide to those who may want to build a set "from scratch".

Vital to the performance of the receiver is the first transistor, a general purpose NPN silicon type, which serves as a regenerative detector. In the original kit the type specified is a 2N5223 but a variety of other general purpose NPN silicon types should work in much the same fashion, as for example: BC239B, BC173, BC108, BC109, BC208; BC209, BC548, BC549, etc. Individual samples of individual types may vary somewhat in their exact behaviour in a regenerative circuit but this can be half the fun provided you keep the leads accessable, so that transistors can be interchanged easily.

A point to watch, when considering alternative transistors, is the matter of connections. If at all possible, check on the particular type and brand you plan to use.

The actual circuit configuration is unusual but has fairly obviously been chosen to permit the use of the simplest possible tuning coil—one with two connections only. To change bands, it is necessary only to clip the two connections into spring terminals.

Accordingly, the detector transistor is used in what is called the "grounded base" or "common base" configuration. While being provided with a DC bias voltage via 100k and 33k resistors, the base is bypassed to earth with a .01uF capacitor so that it is grounded as far as the signals are concerned.

In this configuration input signals are normally fed to the emitter and output is taken from the collector but, at first glance, the circuit does not appear to follow this convention. Instead, the emit-

ter is taken to earth through a fixed and a variable resistor in parallel and is lightly bypassed by a 50pF capacitor.

The tuning circuit is between the collector and its 33k collector supply resistor, the latter being bypassed for high frequencies by a .01uF capacitor. The aerial is fed into the active end of the coil, and therefore to collector by a low value capacitor: 12pF. However, because there is a 50pF capacitor between collector and emitter, the incoming signal also reaches the emitter.

Those familiar with circuit design will recognise the arrangement as one commonly used for a transistor oscillator and, provided the resistance between emitter and earth is kept high enough, the stage will oscillate at a frequency determined by the tuned circuit. To serve as a detector, the amount of resistance between emitter and earth must be maintained just below the value which would permit the stage to oscillate.

In practical terms, with the 500-ohm "regeneration" control set near minimum resistance, the gain (or sensitivity) of the receiver will be very low, partly because most of the signal input is shorted to earth, and partly because there is a minimum of regeneration (or positive feedback) from collector to emitter.

Gradually increasing the amount of emitter resistance in circuit will increase the sensitivity—and selectivity—until a point is reached where the stage suddenly begins to oscillate. With a normal AM transmission this is evidenced by a whistle caused by the local oscillation heterodyning (or beating with) the incoming carrier. With a Morse code transmission, which might otherwise be inaudible, oscillation causes it to be heard as a series of whistles whose pitch varies with tuning.

To avoid causing interference in other nearby receivers, the regeneration control should be kept just below the point of oscillation when listening to normal AM transmissions. If listening to Morse code, adjust the detector so that it is barely oscillating.

Incoming signals, which are "detected" or "demodulated" by the first transistor produce an audio signal which appears across the 33k detector load transistor. They are coupled, in turn, through a .05 (or .047uF) capacitor to a 100k volume control.

The volume control may seem to be redundant in view of the fact that the regeneration control will itself affect gain and therefore volume. There is an important distinction however. By keeping the regeneration control just below the point of oscillation, the tuning system exhibits not only maximum gain but maximum selectivity; as such, it can best separate adjacent stations. If, under these conditions, the signals are so strong as to overload the rest of the receiver, the volume control can be adjusted as necessary, without prejudicing detector performance.

From the volume control, the signal passes to a second transistor, a general purpose PNP germanium type. These are gradually disappearing from dealers' shelves but any number of them are to be found in oddment boxes and discarded transistor radios. Being PNP, the transistor is "upside down" with respect to the NPN detector, with its emitter going to the positive side of the supply and collector to negative, or earth. Otherwise the circuit is ordinary enough, the stage being directly coupled to a third transistor, also a general purpose PNP germanium type.

The original kit circuit specifies type 2SB54 for both audio stages, with type 2SB186 as a possible substitute. In Australia the AC122, AC125 and AC128 would be more commonplace but, in practice, almost any general purpose PNP germanium transistor would probably work, provided you can identify it as such and sort out the leads.

The earphone must be a crystal "earpiece", both to present a sufficiently high impedance load to the output transistor and to avoid interfering with its DC operating conditions. The usual 8-ohm magnetic earpiece would not be suitable on either count. Ordinary high impedance headphones would probably work okay but make sure to connect a low value electrolytic capacitor (1 to 10uF) in series with the active lead to block the direct current path. (Electro plus to collector, minus to earphone.)

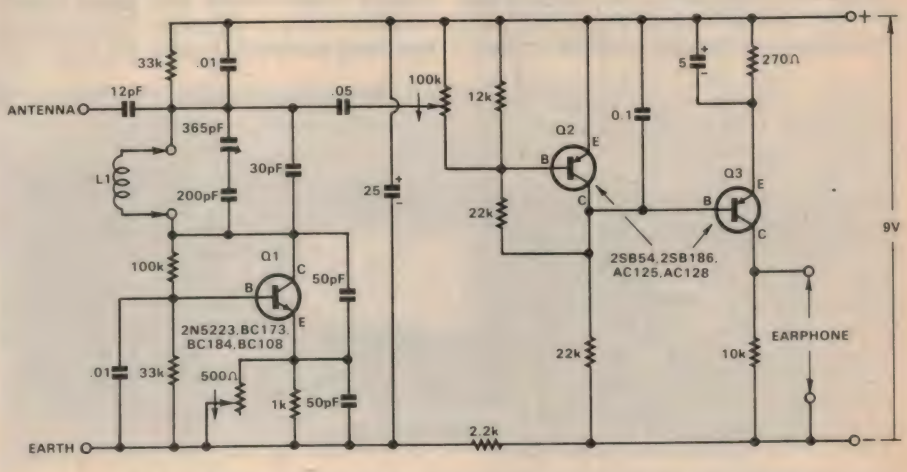
while the coil us still being held in position on the battery, the turns be wrapped with a couple of layers of cellulose "sticky" tape to hold them together. Once clear of the battery, more tape can be added as necessary.

With such a coil the kit literature suggests a frequency coverage from about 20MHz with the capacitor fully open to 13MHz with the plates fully meshed.

If you want to experiment with different bands, we suggest that you wind the coils on rigid formers cut from cardboard or plastic tube with a diameter between ½-inch and ⅝-inch. Or you can make your own "cardboard" formers by glueing strips of brown paper, rolling them to the appropriate diameter and leaving them aside to dry. Wind on the requisite number of turns and secure them in position with tape or, better still, a couple of spots of quick drying adhesive.

The kit leaflet suggests coils which can be wound up to cover other frequencies apparently on the assumption of the same wire (solid-core hook-up or bell wire from a hardware store) which winds to about 21 turns per inch. Assuming a former diameter of about 14mm, the suggestions are: 50-26MHz 2 turns; 28-19MHz 5 turns; 20-13MHz 8 turns; 14-9MHz 15 turns; 10 to 6MHz 25 turns; 5.7 to 4MHz 40 turns.

To extend the coverage to below the 3.5MHz amateur band, we suggest you go to a larger diameter former, say 25 turns on 1-inch diameter.



Power for the receiver comes from a 9V "transistor" battery, the current drain being just over 1 milliamp. No off-on switch is envisaged in the original kit, the idea simply being to slip the plus wire out of its terminal. A simple switch could, of course, be added if so desired.

And now a word about the tuning coils and frequency coverage. The original kit contains a length of insulated solid-core hook-up or "bell" wire which is used, in part, for connecting leads. However, the instructions suggest cutting a 16½-inch length of the wire and using it to wind an 8-turn coil around an AA battery—giving an effective internal diameter of about 14mm. It is further suggested that,

The set is not well suited to broadcast band coverage, partly because the capacitor cannot cover the whole band, and partly because the regeneration circuit is not optimised for the much lower frequencies. However, you can try clipping the secondary winding of an ordinary aerial coil between the terminals or, more conveniently, a commercial VPC 350 peaking choke.

And the aerial? Typically about 20ft or so, supported as much in the clear as possible. An earth wire will also help, connected either to a metal spike driven into moist ground, or clipped to something earthed via the power mains.

Solid state 3.5MHz novice transmitter

Here is another project for those readers who are radio amateurs—and in particular, for those who have recently gained their Novice licence. A fully solid state AM/CW transmitter for the 3.5MHz band, it uses a novel approach: a low level modulated exciter driving a broadband linear.

by IAN POGSON

In April last we described a 27/3.5MHz transverter, intended for holders of the new Novice licence—and other amateurs—who already had a transceiver on 27MHz. With the two pieces of equipment, they would then be able to get started on the 3.5MHz amateur band. Readers who are familiar with the transverter in question will know that it incorporates a wideband linear amplifier with high gain, capable of giving 10 watts of RF into an aerial system.

While we were preparing the transverter for publication, we realised that the linear amplifier had quite interesting potential for a number of other applications. One possibility was for a simple crystal controlled 3.5MHz AM transmitter, using an exciter amplitude modulated at low level and then amplified to the required power level by the linear amplifier.

The completed prototype, housed in a simple, inexpensive aluminium case.

This arrangement has been put into practice, and the result is the new solid state Novice AM transmitter shown here. The new exciter is made up on a printed board, the same size as the mixer board of the transverter project—which it replaces, mating with the original linear board. The changeover relay has been incorporated into the exciter board, the same as previously. In point of fact, we are still using the same metalwork as was used for the transverter. All that is required is a few extra holes.

The exciter circuit is relatively straightforward. The RF generator consists firstly of a simple 3.5MHz crystal oscillator, using any one of the readily available small signal transistors such as the BC208, BC548, BC108, etc. Output from the oscillator is from the emitter circuit, via a 60pF trimmer capacitor which functions as a drive control. This is followed by a buffer stage, with tuned collector. The buffer then drives the modulated amplifier via a suitable impedance matching network. Unlike the two former stages, the modulated amplifier uses the grounded base configuration. The collector is tuned and the output is fed via an impedance matching network into a 2.2k potentiometer, which functions as a drive control to the linear amplifier.

The speech amplifier accepts output from a microphone, via a 47k resistor which allows for satisfactory operation from either low or high impedance dynamic microphones. The 47k resistor and the 220pF capacitor form an RF filter, thus ensuring freedom from RF getting into the speech circuits, with possible problems.

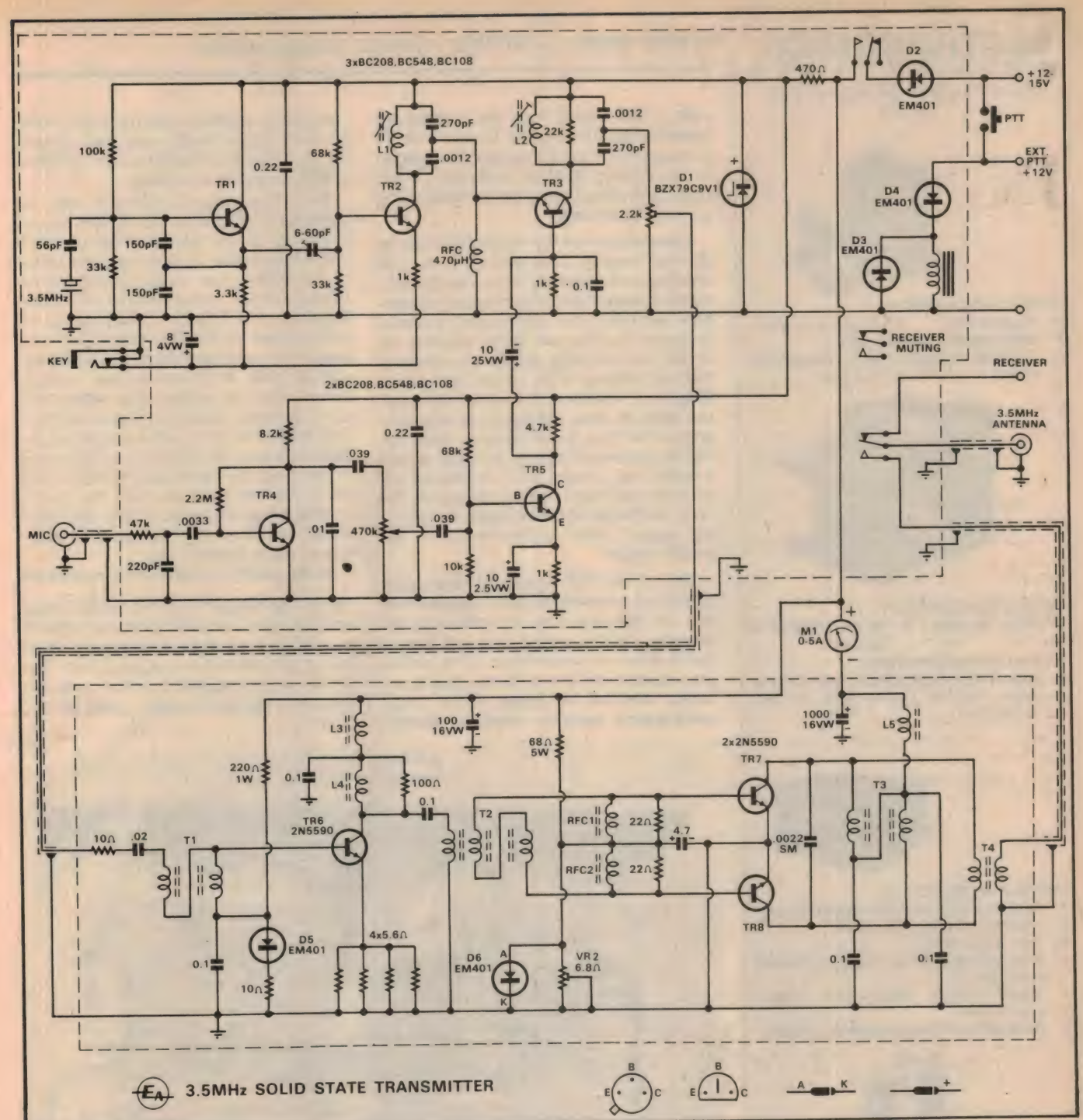
Output from the speech amplifier is via a 470k audio level control, which in turn, feeds the modulating amplifier. Frequency response of the audio circuits is shaped by the use of suitable coupling and by-pass capacitors. These give a suitable roll-off at both low and high frequency ends of the speech range.

Output from the modulating amplifier is taken via a 10uF electrolytic capacitor to the base of the modulated RF amplifier. The 1k resistor in the base is the load into which the modulating amplifier works, varying the base bias at audio frequencies and thus achieving amplitude modulation.

It will be noticed that the base of the modulated amplifier is bypassed for RF, but not for the required audio frequencies. The reactance of the 0.1uF capacitor is low at 3.5MHz, but its reactance is still high relative to 1k at audio frequencies. It does provide some treble rolloff, used to help shape the audio response.

Early in the development of this exciter, we used a small transistor driver transformer as a modulation transformer. This worked out very well, but transformers are expensive and take up quite a bit of space so we decided to dispense with it if at all possible. The system of base modulation which we have adopted has proved quite satisfactory, so a transformer cost has been saved—offset only by the cost of two resistors and two capacitors.

For the CW enthusiast, we have provided for keying of the exciter as well. Keying is done in the emitter circuits of both the crystal oscillator and the buffer. Reasonably satisfactory keying was achieved initially by simply keying the emitter circuit of the buffer, but there was still some RF leakage getting through into the linear. Although this may not have been a problem over long distance working, it may well have resulted in a "back wave" effect over shorter distances. By keying the oscillator as well, this problem has been overcome. The 8uF electrolytic capacitor across the key



ensures freedom from possible key clicks.

The exciter and speech circuits are operated from a 9.1V regulated supply, derived from the main 12 – 15V supply via a 470 ohm dropping resistor and a 9.1V zener diode. Diode D2 is used for reverse polarity protection. Also, the relay will not operate on reverse polarity from a separate PTT supply because of diode D4. In addition, D3 prevents spikes from the supply rail from operating the relay.

One set of relay changeover contacts is used for aerial changeover. A second set of contacts is used to switch the supply rail to the transmitter and the third set is available for use for receiver muting. The fourth set of contacts is not used.

The second PC board contains the original linear power amplifier, consisting of TR6 as driver and TR7, TR8 and the push-pull final power amplifier. The complete power amplifier is broad banded, unlike the more conventional tuned approach. This does away with the usual rather large tuning components. T1, T2 and T3 are broad band transformers wound on ferrite balun cores. Diodes D5 and D6 are used to control the bias necessary for linear operation. As the power transistors have a relatively high DC current gain, some form of protection is necessary to prevent thermal runaway and so the bias supplies have been made relatively stiff.

Transformer T1 is a step down coupling from the output from the exciter board to the base of driver TR6. The 10 ohm resistor at the input of T1 has been added in the interest of driver stage stability. Inductor L3 and the 0.1uF capacitor are decoupling for TR6, whilst inductor L4 is loaded with 100 ohms to reduce the possibility of stray resonances in the collector load circuit. This circuit is then capacitively coupled to the step down transformer T2, which divides the signal to feed the bases of the output pair TR7 and TR8. RFC1 and RFC2 are similarly loaded with 22 ohms each to reduce the possibility of unwanted resonances.

T3 in the power amplifier collector cir-

Solid state 3.5MHz novice transmitter

cuits is the supply feed and combining transformer. The output transformer T4 transforms the low impedance output up to the desired 50 ohms. Inductor L5 and two 0.1uF capacitors provide decoupling for the ouput stage.

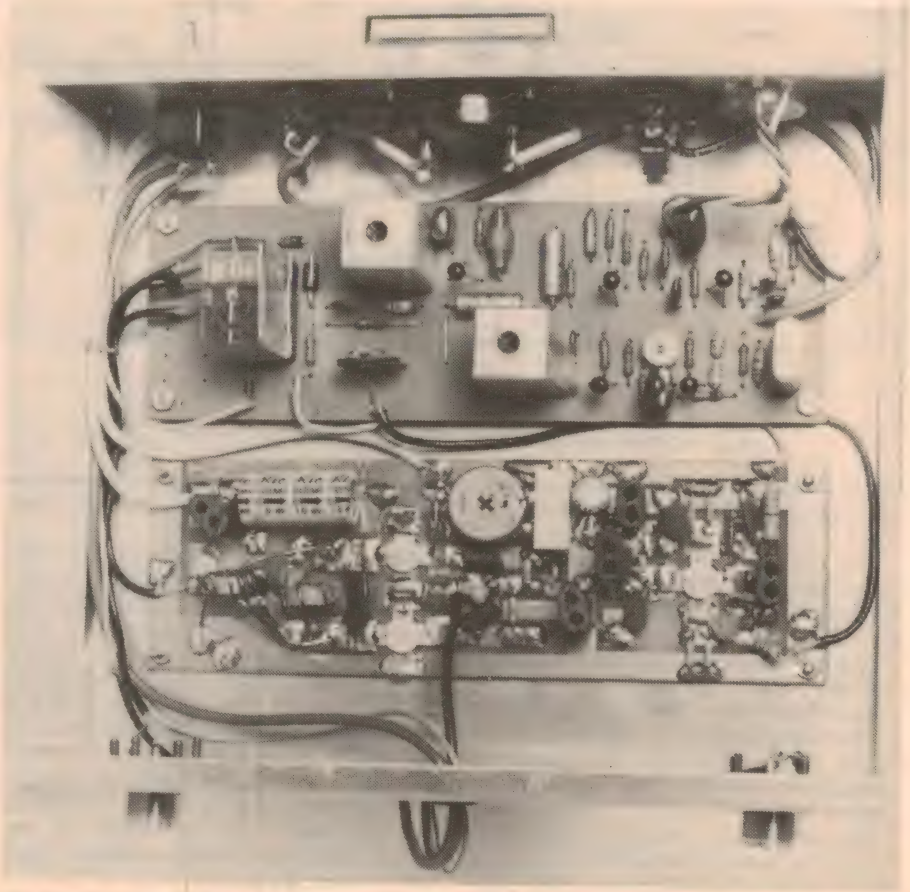
Construction of the transmitter can be divided broadly into two sections, coil winding and assembly of the two boards. As the boards cannot be properly assembled until the coils are wound, it seems logical to do this part of the job first. All of the coil winding details are given in the coil winding table and in the various diagrams. Winding the coils, although not difficult, does call for a considerable amount of care, particularly in terminating the various windings. In cases where a centre tap is not used it should be cut off fairly short and bent up alongside the core, so that there is no danger of it shorting against other components, or the board copper.

The exciter PCB is probably the easier of the two to assemble and I suggest that you do that one first. By following the drawing for this board, you will find it quite easy to assemble. The usual precautions and procedures should be taken. Start off by fixing all the small components such as resistors, diodes, capacitors, and then add the larger components. Make quite sure that diodes, electrolytics and transistors are all fitted with due regard to polarity.

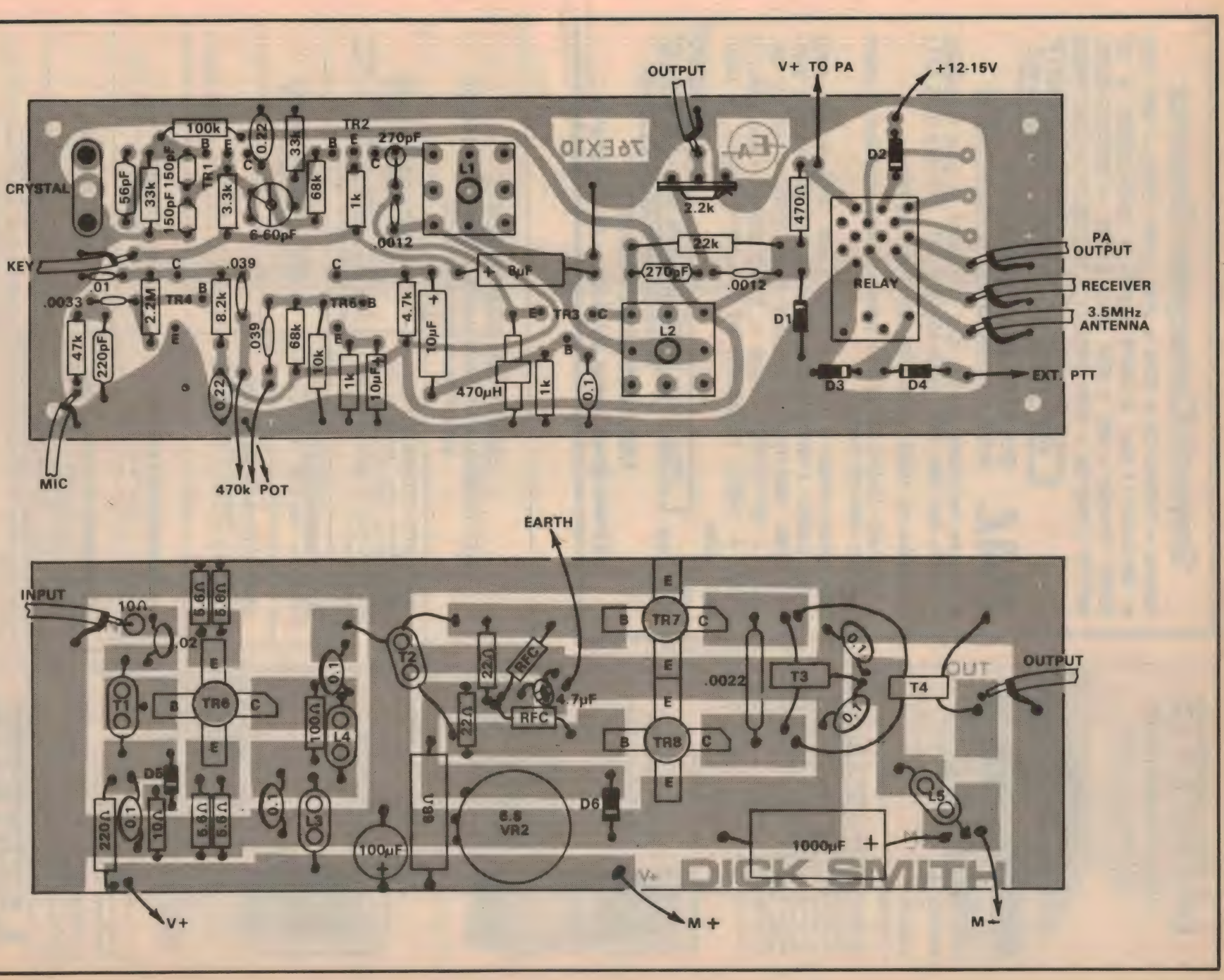
The linear amplifier board may be assembled next. Guided by the layout drawing, it will also be up to each individual builder to determine the order of assembling the various components. Where some components are close together, it will become obvious as to which ones to fit first. Particular care should be exercised when mounting the various coils and transformers, making certain that the centre taps where not used, are kept clear of other conductors. The added 10 ohm resistor right at the input will only be soldered to the board at one end, the other end will be stood off the board ready to take the centre conductor of the input cable. Do NOT solder the three 2N5590 power transistors in place at this stage.

At this point, we can turn our attention

The wiring diagrams for the exciter board and the linear amplifier board are shown at right and far right respectively. Both boards are shown actual size. Note that for the linear amplifier, components are mounted on the copper side of the board.



An interior view of the transmitter with the wiring complete. The exciter board is situated directly behind the front panel, with the linear amplifier to the rear.


OUTPUT
V+ TO PA
+12-15V
CRYSTAL
KEY
MIC
470k POT
RELAY
D1
D2
D3
D4
PA OUTPUT
RECEIVER
3.5MHz ANTENNA
EXT. PTT
L2
470µH
INPUT
EARTH
OUTPUT
V+
M +
M −
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to the metalwork. Holes should be drilled to take the two coaxial sockets and the rubber grommet on the back panel. Also, holes should be drilled to take the meter, potentiometer, jacks and switch on the front panel. Four holes also have to be drilled to take each of the two PCBs. These holes should be located so that the front edge of the exciter board is 30mm behind the front panel. Similarly, the back edge of the linear board should be 30mm from the back panel. This leaves a space of about 10mm between boards.

The linear amplifier board should be temporarily screwed into place and the three holes for the power transistors should be carefully marked on the bottom of the box. Clearance holes should then be drilled to take the screw thread of the transistors. These holes should be deburred.

Before mounting the PCBs permanently, the coax and other leads from the exciter board should be soldered in place and each lead cut to length to reach its ultimate destination. This done, mount both boards and in the case of the exciter board, use two nuts between the board and the case to act as spacers. Only one nut spacing is used in the case of the amplifier board.

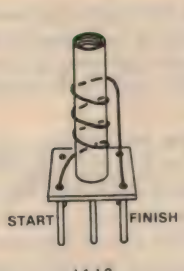
Mount the components on the front and back panels, and then all interwiring between these components and the boards may be done. Leads to and from the meter should be run in heavy cable, preferably coloured red for positive and black for negative.

On the circuit may be seen a separate lead marked "Ext PTT +12V". It is normally intended that this lead be incorporated into your PTT system so that the relay on the exciter board will be operated when the appropriate switch is operated. This must be left to the reader, as each situation must be dealt with individually. The switch on the front panel of the transmitter is provided as an over-ride switch.

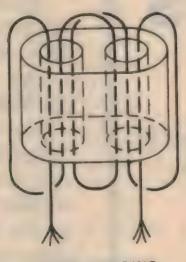
On the linear amplifier, we bent up the ends of the connection lugs of the 2N5590 transistors. About 2mm or so was bent up at right angles at the end of each lug. This effectively shortens the lugs and also allows a small amount of pressure to be applied to each lug as it is soldered in place. After bending, tin each lug, together with the corresponding areas on the board. Mount the transistors and screw each one in place with the nut supplied and with the dot indicating the collector. They may now be soldered at each of the four points.

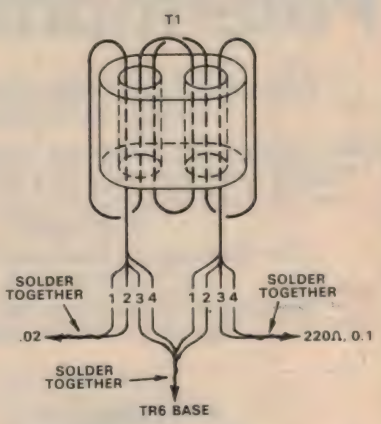
With the unit completely wired and assembled, a thorough check should be made of all work, making sure that all components are in the right place and that polarities are correct where necessary. Satisfied that all is well, a power supply is needed that will deliver between 12 and 14 volts, preferably 13.8 volts, at

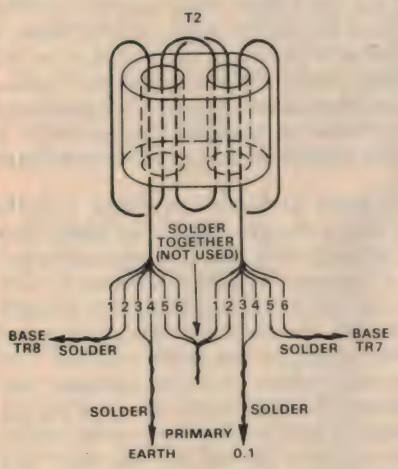
COIL WINDING DATA FOR 3.5MHz TRANSMITTER

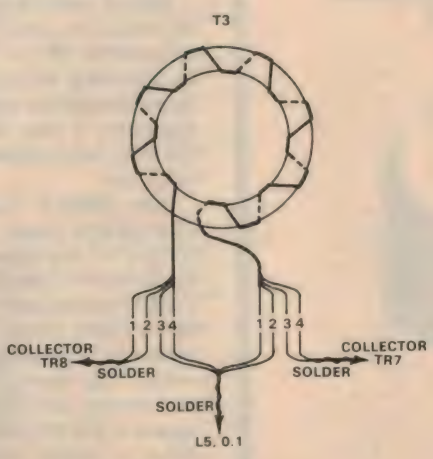


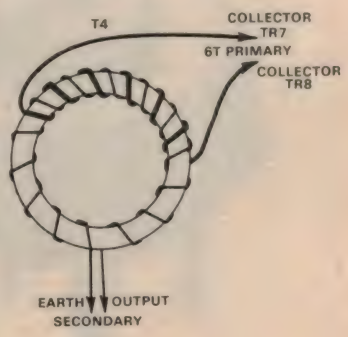
L1,L2


BASIC WINDING









TRANSMIT Coil Data

L1, L2. 50 turns 28B & S enamel c/w on Neosid 7.6mm former, 32mm long with grade 900 slug.

L3, L4, L5. Parallel four strands of 28B & S enamel wire and twist together evenly with about 10 twists per inch. Wind on balun core as shown in drawings and then carefully terminate as shown in drawing. Centre tap not used.

T1. Wound and terminated the same as L3-4-5 but centre tap used.

T2. Parallel six strands of 28B & S enamel wire and twist together evenly with about 10 twists per inch. Wind on balun core similar to previous units above and carefully terminate as shown in drawing. Centre tap used.

T3. Parallel four strands of 28B & S enamel wire and twist together evenly with about 10 twists per inch. Wind eight turns on 4C6 toroid and carefully terminate as shown in drawing.

T4. Wind secondary of 14 turns of 20B & S enamel wire on 4C6 toroid. Then wind primary of six turns of 16B & S enamel wire over secondary as shown in drawing.

RFC1, RFC2. Wind in formers by running 26B & S enamel or TC wire continuously through five of the six holes, giving a winding end at each end of the former.

3.5MHz novice transmitter

about 1½ amps. However, if you have ideas of going to SSB, with modifications in the future, then it would be wise to make sure that the power supply will deliver about 2½ amps normally, with peaks of up to 5 amps. A car battery may be used for the power supply. You will need a dummy aerial, 50 ohms non-inductive and capable of handling at least 10 watts. You will also need a CRO and an audio generator for some preliminary adjustments.

Before embarking on the main job of alignment, there are a few preliminary checks which must be made. Set the 6.8 ohm variable resistor VR2 so that there is no resistance in circuit. This cuts off any forward bias on the output transistors TR7, TR8. Connect the dummy aerial to the output and connect the two power supply leads to the supply. Set the 2.2k drive trimpot to its off position, with the rotor at the earth end.

Now operate the PTT switch on the front panel, at the same time watching the 5A meter. The meter should show little or no reading. If it swings full scale, there is obviously trouble. This should not occur in your case, however, as we have added the 10 ohm resistor at the input to the driver to stop the driver from "taking off".

Assuming that all is well, now take a voltage measurement at the emitter of the driver transistor TR6. Readings we took were 0.42V and 0.45V on the two units available. Your reading should be close to these figures.

Now adjust the variable resistor VR2 with a screwdriver, and set the collector current for the final at between 0.1A and 0.2A. This corresponds to between half and one division on the meter scale. Switch off the PTT and this concludes the preliminary adjustments.

Now we are ready to adjust the exciter. If your CRO will respond to the signal frequency of just over 3.5MHz, then it may be used to advantage. Connect the CRO across the 2.2k trimpot, with it still turned off so that no drive is delivered to the linear amplifier. If your CRO is not suitable, then the signal may be tuned in on your receiver and adjustments made while using the signal strength meter as an indicator.

Before switching on, set the 6-60pF drive control trimmer between the oscillator and the buffer stage, so that there is only about 10% of capacitance in circuit. Now switch on and by adjusting the sensitivity of the CRO or receiver to suit, a signal should be indicated. Adjust the slug in L1 for maximum response. It may be necessary to readjust the sensitivity of the CRO or receiver. Now adjust the slug in L2 for maximum response.

Now feed in 1000Hz from an audio generator into the microphone input, and adjust the generator and audio level control on the transmitter until 100% modulation is achieved. If you have been using a receiver for adjustments up to now, it will be necessary to use a CRO which can check the modulation. All this done, it may be observed that the positive half cycles of the modulation envelope are being crushed. This means that there is too much drive from the oscillator and the trimmer should be reduced in value until the crushing disappears. On the other hand, it may be that there is not enough drive, in which case the trimmer should be advanced until crushing occurs. It should then be reduced slightly.

The trimmer drive adjustment is rather critical and it should be done with due care. However, once done, it should not have to be touched again, given a reasonably stable power supply voltage.

With the modulation still set to 100%, connect the CRO across the dummy load and advance the 2.2k trimpot drive control to the linear amplifier, until 1 amp is indicated on the meter. It will be necessary to readjust the CRO sensitivity. The pattern should be a duplicate of that observed from the exciter. If the positive half cycles of the modulation envelope are crushed, the drive to the linear amplifier should be reduced until the crushing disappears. On the other hand, it may be possible to advance the drive so that the meter indicates 1.1 amps or so before crushing occurs.

LIST OF COMPONENT PARTS

1 Case 230mm wide x 200mm deep x 65mm high
1 Meter, O-5A, 52mm x 48mm (Q2030)
1 Toggle switch, SPST
1 Knob
2 Coax sockets
2 6.5mm jack sockets
1 Rubber grommet
4 Mounting feet
1 PCB for linear amplifier (Dick Smith Electronics)
1 PCB for exciter, 195 x63mm, coded 76EX10
1 Relay, 4 c/o, 185 ohms, 21/4CA or similar
1 Socket for relay
1 Crystal, style D, ambient temperature, 30pF, .003%, selected frequency in 3.5MHz band
1 Socket for crystal
5 Balun cores, Philips 4312-020-36640
2 Choke formers, Philips 4312-020-36640
2 Toroids, Philips 4322-020-91020
2 Coil formers, Neosid, 7.6mm x 32mm with can and grade 900 slug
3 Transistors, 2N5590
5 Transistors, BC208, BC548, BC108, etc
5 Diodes, EM401 or similar
1 Zener diode, BZX79/C9V1 or similar
1 470uH RF choke

RESISTORS (¼W unless stated otherwise)
4 5.6 ohms
1 6.8 ohms tab pot, Philips 2322-011-02688
2 10 ohms
2 22 ohms
1 68 ohms 5W
1 100 ohms
1 220 ohms 1W
1 470 ohms
3 1k
1 2.2k trimpot
1 3.3k
1 4.7k
1 8.2k
1 10k
1 22k
2 33k
1 47k
2 68k
1 100k
1 470k log pot
1 2.2M

CAPACITORS
1 56pF 630V polystyrene
1 6-60pF Philips plastic trimmer
2 150pF 630V polystyrene
1 220pF 125V polystyrene
2 270pF 125V polystyrene
2 .0012uF 200V greencap
1 .0022uF silver mica
1 .0033uF 200V greencap
1 .01uF 200V Greencap
1 .02uF 50V ceramic
2 .039uF 200V greencap
1 0.1uF 100V greencap
5 0.1uF 50V ceramic
2 0.22uF 100V greencap
1 4.7uF 30VW tantalum
1 8uF 4VW electrolytic
1 10uF 2.5VW electrolytic
1 10uF 25VW electrolytic
1 100uF 16VW electrolytic
1 1000uF 16VW electrolytic

MISCELLANEOUS
Coax cable, heavy and light hookup wire, winding wire (16B&S, 20B&S, 26B&S, 28B&S, 34B&S), solder, screws, nuts.

Note: Resistor wattage ratings and capacitor voltage ratings are those used in the prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings may also be used in some cases, provided the ratings are not exceeded.

The adjustment just described will vary quite widely as to the amount of current which the linear amplifier will draw before crushing of the modulation envelope occurs, according to the actual voltage of the power supply. In turn, this will all be reflected in the amount of RF power output which is realised. With the recommended 13.8 volts, a very satisfactory performance may be expected. It would also be wise not to push the supply too much beyond 14 volts, although a maximum of 15 volts is indicated on the circuit.

The final is capable of being driven to 20-30W PEP and it is also capable of being driven to this level on CW, although if this is done on a prolonged basis damage may be done to the output transistors.

It is worth noting that if the two final transistors are replaced with a pair of 2N5591s, the final may be driven to 40 or 50W.

The transmitter is designed for a 50 ohm aerial system. It is essential that this be observed and the SWR should be less than 1.5 for correct operation. Also, full output will not be realised unless this is so. In addition, the final may produce spurii unless it is correctly terminated. As the linear is broad banded, harmonics are present and if the transmitter is to be used on a broad band aerial such as a trap dipole or similar which will respond to harmonics, the unit should be used with an aerial tuning unit or a low pass filter. If the transmitter is to be used on a mobile whip or a high Q aerial system, then no filter is necessary and the output may be fed directly to the aerial, making sure that it is 50 ohms.

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- Red patterns with 50% saturation
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Conducted by Neville Williams

STEREO: What does the word mean?

A letter from a reader in Victoria calls into question the almost universal use of the description "stereo" and, in so doing, raises once again a much argued question: what are we trying to achieve in a recording? Recreation of an original environment, or technological conformity, or an experience unique to the listening room? We have to resolve those matters first before we can debate properly the point raised in the letter.

The above may sound something of a mouthful but the implications should become clear enough as you read on. But first the letter:

Dear Sir,

In view of the complete dominance of the term "stereo" for high fidelity sound reproduction, it would be of the greatest interest to know if stereo is really available today in the majority of commercial recordings.

For true stereophonic recording and reproduction, it is fundamental that there be two effective channels right through the chain for all sounds. It seems, however, that most recordings available today are made by the multi-channel method, using single microphones for individual performers, the signals being mixed to produce the final commercial recording.

This must surely result in "two channel mono", giving an impression of lateral dispersion of the performers on playback, but not true stereophonic reproduction.

Unless we return to the original concept of stereo, the wasteful use of two channels would appear to have little justification, since the realism attributable to stereo is simply not present.

Although the result may sound pleasant to some people, I personally do not consider it to be true stereophonic sound.

I would be pleased to hear your views on this subject.

R.P. (Parkdale, Vic.)

Those who have been through it before, will recognise all the elements in this letter that I mentioned at the outset: original environment, technology or an enjoyable end result!

At the risk of "beating the drum" a bit, I'd like to dwell on the environment because it has implications which affect the other two.

Twenty years ago, or more, a scarcely questioned axiom was that the ultimate objective of any high fidelity exercise was to recreate accurately the original listening experience—full stop! Surely there could be no greater tribute than the observation that: "when I closed my eyes, it was just as if I was right there in the (fill in the name) Hall! To suggest anything else branded you as something between a Philistine and phool!

Our Editor, at the time, the late John Moyle, was a classical music enthusiast, a regular concert goer and a record reviewer. Yet, to the horror of his conservative contemporaries, he could argue the viewpoint of a "Philistine" with considerable force and conviction. Since it was one of his pet subjects, pursued with great delight in "long hair" musical circles, I can offer only a tame precis of his themes.

"Long Hair" musical circles . . . ? I am going back, of course, to the short-back-and-sides era of the fifties.

To be sure, one legitimate objective of a recording or a broadcast is to simulate a direct listening experience as far as possible. It may involve a classical concert, a grand organ recital or a pop occasion. It does not follow, however, that this is the only legitimate objective. Other considerations and aspirations can and do—intervene.

At an elemental level, a dominating sense of "being there" may involve diverse and even conflicting factors. It may call for a deliberate content of audience noise and response, and a distinctive content of venue acoustics. Both may prejudice a third factor: a desire to hear the particular performance to advantage, uncluttered by incidental noise and echo. These days, the last would appear to be an often dominant consideration.

Rarely indeed would a broadcasting or recording engineer try to achieve a sense of "being there" by standing a microphone on a seat in the middle of the audience. He seeks a quite different balance between sound source, reverberation and audience noise by supporting the microphone somewhere up in the air, where no member of the audience ever sits!

You may think that I'm splitting straws but, believe me, there is a point here: in order to achieve an acceptable result at the remote listening point, even a conservative engineer is likely to choose a non-typical listening position for the microphone. It's the first hint that a broadcast or recording, to be considered successful, must be biassed quite deliberately in favour of the source sound.

A second step may be to use additional microphones for ambience and audience "contributions", and possibly for an announcer, narrator or artist so that the final blend is controllable. A third step would be to eliminate the audience altogether, dismissing all pretence of "an occasion" and concentrating entirely on a performance.

Once the audience is eliminated, the soloist, or conductor, or producer, or engineer at a recording session is free to abort any movement or segment or track, in order to "have another go". What you may ultimately buy over the counter may well be a superb recording of a superb performance that never happened as an entity! It's commonplace in the popular field but it happens, too, at the classical level.

Before one gets all upset at this "dishonesty", it is well to remember that there is a world of difference between an unhappy event in a single performance and a similar event in a recording, which is likely to be reproduced many times. In a single performance, a hesitation or a wrong note may surprise momentarily, and be the subject of later comment but, after that, it is largely forgotten. In a recording, the same imperfection is emphasised by repetition and anticipation to the point where it can become quite excruciating. And, if imperfections are so much more obtrusive in a recording, it is surely not unreasonable to take special measures to eliminate them.

In short, without getting involved at all in arguments about mono or stereo, microphones or technical definitions, it becomes evident that a recording cannot be defined or judged as a mere encapsulation of an audience occasion. In most cases, it is the end result of a performance designed expressly for a recording, and therefore for reproduction in the home. By implication, it confers on those responsible the right to choose whatever technology will best serve that objective.

John Moyle used to argue strongly that listening to a performance in the home

STEREO: What does the word mean?

is so personal that it is indeed unique, having little in common with a mass audience situation. It is an art form in its own right and to optimise it is just as legitimate an objective as the simulation of an audience occasion. Under the more intimate listening conditions of a living room, one may well be in a position to hear subtleties that would be lost in a public performance.

He often used to speculate as to how the great composers might have reacted if they'd had access to microphones and amplifiers, rather than being limited to what could be done with instruments and vocalists unaided in typical auditoria. And, while it is still conventional for classical musicians and recordists to observe the constraints of earlier years, is it really such a sin to use a spot microphone to achieve properly what yesterday's composers could only struggle to achieve indifferently?

So then, if a recordist is convinced that he can provide a cleaner, more transparent recording for home listening by using multiple microphones, rather than a Blumlein pair, is there any logical reason why he should not do so? To be sure, multi-miking puts a greater responsibility on to the engineering staff but their work is going to be judged, anyway, by the final sound.

So much, then, for what I referred to earlier as the background.

In his letter, R.P. does not refer directly to any of these matters, expressing concern only about the technical implications of the word "stereo". His is a very hard-line view: with a Blumlein style microphone it is stereo; with multiple mikes it is something else; if it is the latter, it is simply a channel wasted: ". . .the realism attributable to stereo is simply not present . . . although the result may sound pleasant to some people . . ."

If R.P. had been upholding a binaural system, he would have been on more sure ground, because a binaural system comes much closer to transporting a dual sound pattern at two microphone diaphragms to the corresponding ears of the listener. Once the signal is applied instead to a pair of loudspeakers and made to traverse a complex acoustic path to the listener's ears—we enter an entirely different ball park. The sounds generate their own local ambience; both sounds are heard by both ears; all the original auditorium and audience ambience emanates from the same frontal area as the performance—a very strange auditorium indeed!

So R.P. can hardly defend Blumlein stereo on the grounds that it is intrinsically "pure". Any superiority it might have over multi-mikes would be a matter of degree—not black or white, but different shades of grey.

Photo by courtesy of Convoy International Pty Ltd, of Woolloomooloo, Sydney.

What he seems to have overlooked is that, in any ordinary stereo system, the apparent position of a discrete sound source is largely determined by the relative loudness of the signals in the respective loudspeakers. This is true, whether the loudness differential is the natural result of using a complementary Blumlein pair or microphones, a spatially separate pair, or the result of a more complex mixing operation. Whatever the method, both channels play their part in positioning sources within the sound field. Neither is idle; neither is superfluous.

R.P's definition of a non-Blumlein approach as "two channel mono" ignores the vital interactive relationship between the channels. The fact is, of course, that non-Blumlein stereo has at least an equivalent potential for definition and separation and therefore an equivalent potential for realism, in terms of lateral dimension. If one wants to argue further the concept of "realism", it would have to be in relationship to ambience and other such qualities discussed at the outset.

Let's go one step further: one of the criteria by which we judge a stereo system is its ability to pinpoint individual sources on the sound stage—in short, its ability to create a virtual mono image, hopefully no wider than a singer's mouth or the bell of a trumpet.

On this basis, the sound image of an orchestra can be regarded as being made up of a whole array of virtual mono images, side by side, across the sound stage. Fairly obviously, the sources can be positioned in the recording, analog fashion, by the natural action of a Blumlein pair, or by discrete positioning by way of mike placement and/or mixing.

Whether desirable or otherwise, the use of multiple microphones and mixers is, as often as not, a matter of necessity rather than choice. To record an orchestra, chior, or other large sound source with a single microphone (or microphone cluster) it is necessary to get well back, in order more to equalise the multiple acoustic paths. In practice, it normally involves recording in an auditorium or a very commodious studio. That means limited access, high rental cost, equipment problems and pressure to get the performance on tape within the allocated time limit.

Not surprisingly, producers often have to settle for a regular studio where there just isn't room to arrange an orchestra or choir in the classical pattern, or to place a microphone cluster at a suitable common listening point. Nor is it possible merely to disperse a few mics around the place to pick up instrumental groups, because the drums, for example, may swamp all mics and all channels.

As often as not, one finds an array of acoustic screens in such studios, which provide some isolation for various instruments and groups—each with their own microphone(s), mixer channel(s) and tape track(s). Much later, when all the highly paid performers have gone home, the operator(s) and producer set about the task of blending the tracks and mixing them down to a 4-channel or 2-channel master. If they're lucky, they'll have an automated system to memorise their progressive settings and to re-run them at the push of a button.

In so doing, they can add a touch of reverberation, position the sound sources acoustically where they want them, and irrespective of how they were arranged in the studio. And that's the way the listener will hear them and, hopefully, enjoy the end result.

Artificial? Contrived? Non legit? That depends on the point of view—and brings us right back to where we started!

If the prime role of a recording is to encapsulate an occasion, then those words, and more, could be justified.

But, if the object is to create a program for domestic listening, as an art form in its own right, the artists, the producer and the recordist must be conceded the right to pursue that end by any means that are appropriate.

In expressing his point of view, R.P. is, of course, in a large and distinguished company, with a majority dedication to classical music and the classical format. In this area, they are generously catered for by recordings and broadcasts in the traditional style.

What we are saying, largely, is that they shouldn't be quite so convinced about the lily-white virtues of traditional stereo, quite so intolerant of methods used in the popular field, or quite so condescending to the "some people" who find another end result pleasing.

Perhaps I should add: and quite so disdainful of those who are trying to capture and recreate more genuine around-the-listener ambience, with the aid of discrete 4-channel!

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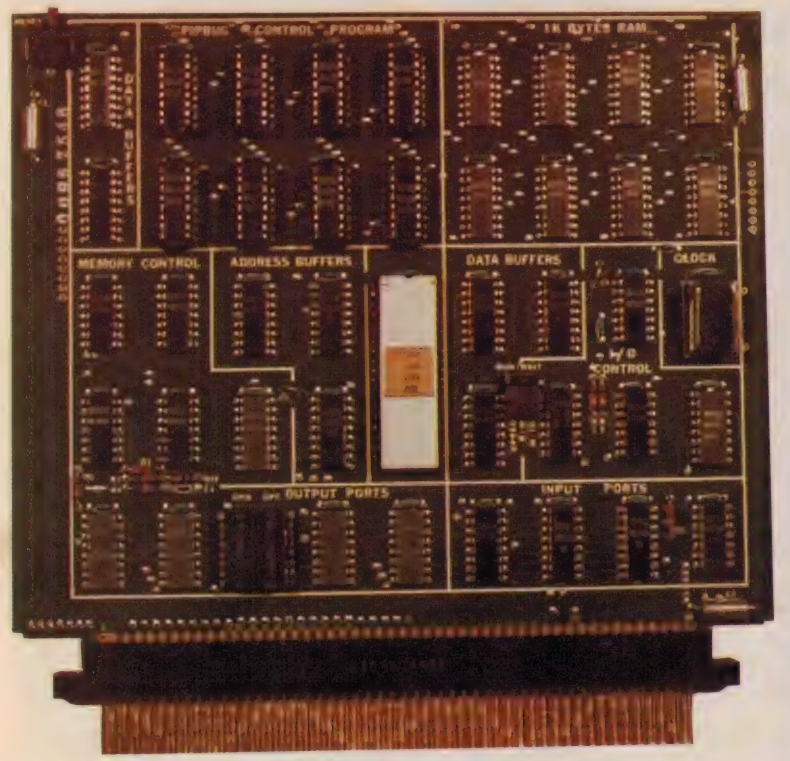

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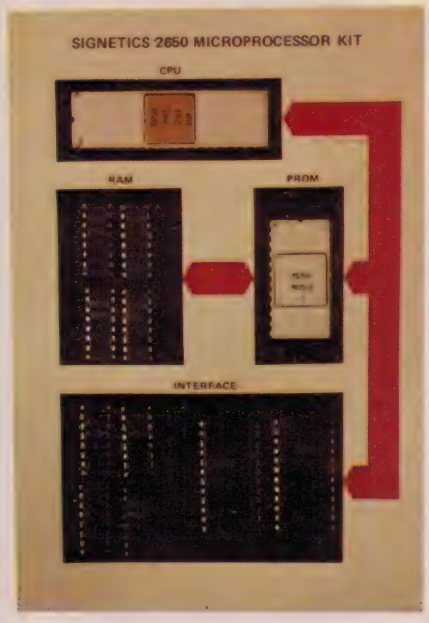

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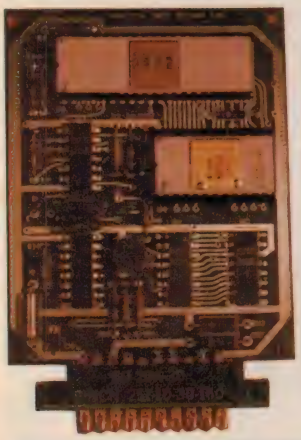

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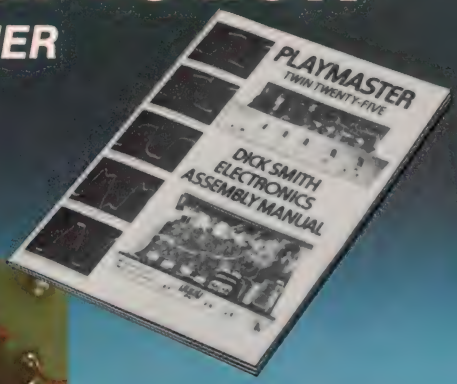

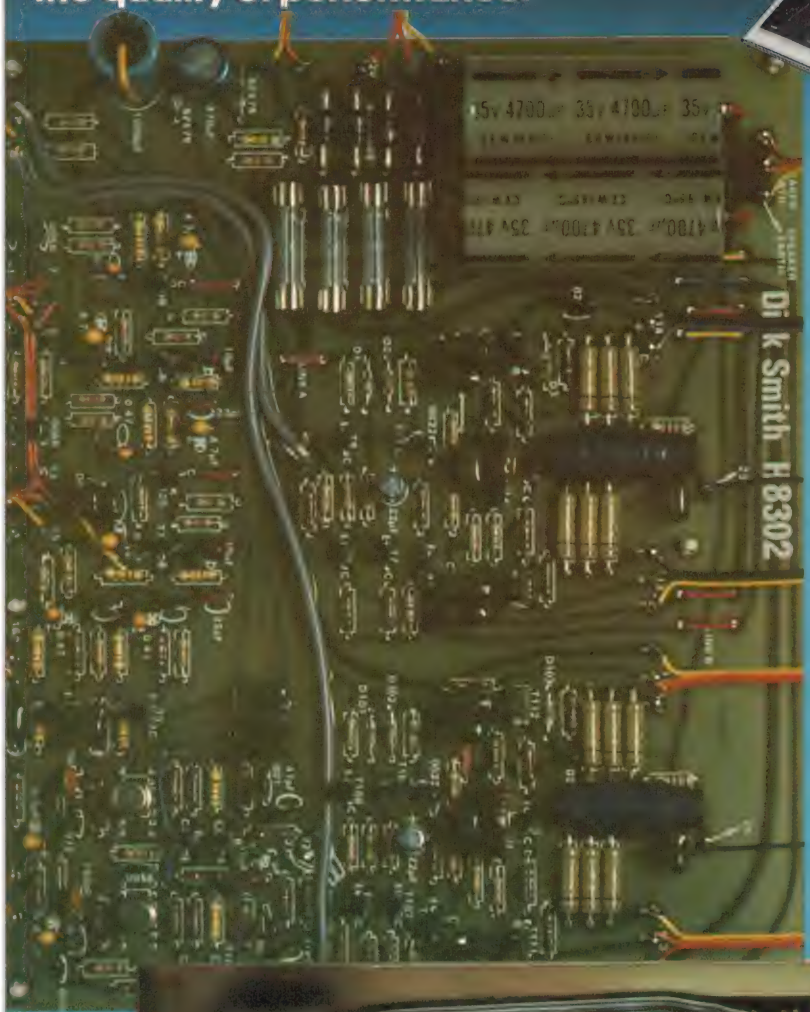

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Feedback from readers and retailers on the

Playmaster Twin 25 stereo amplifier

Over one thousand Playmaster Twin Twenty Five stereo amplifiers have now been built, and we have had some useful feedback from readers and retailers. Here we answer some pertinent correspondence from readers and deal with other points which have arisen since the original articles were published.

by LEO SIMPSON

Considering the relative complexity of the circuit, the amplifier has proved to be remarkably trouble-free. Most of the faults which have occurred in those returned to kit retailers have been due to poor soldering, incorrect wiring or incorrect insertion of the transistors, particularly the drivers. However, the circuit is fairly tolerant in this regard and few readers have actually damaged transistors.

Now let us deal with the bugaboos which have been brought to our attention by alert readers. The first letter queries some features of the power amplifier design:

There are a few points concerning the Twin 25 power amplifier I would like to get clarified.

Firstly, Leo Simpson states that there is "voltage drive to the output stages and thus forces them (the output stages) to operate with a bandwidth of almost Ft . . ." Well, looking at the circuit diagram, it is of little consequence whether T11 and T12 are being voltage or current driven as T13 and T14, having a much lower Ft, will introduce a pole in the frequency response long before T11 and T12 have a chance to. Elsewhere in this letter it is established that T13 is voltage driven and thus operates to almost Ft. However, it is also seen that T14 is being current driven and therefore operates to, at most, Fβ beta times lower that Ft. Thus a situation exists where the positive excursion will have a substantially different slew-rate than the negative excursions, the negative slew-rate being hardly commensurate with low THD design. The situation can be greatly improved however, at no increase in cost, by making T14 a PNP transistor (eg, the readily available 2N5873) and appropriate., onnecting it so as to have a truly complementary output stage.

The 500kHz open-loop bandwidth figure quoted by Mr Simpson would almost certainly be the small signal frequency bandwidth whereas had the power bandwidth, or equivalently , the slew-rate been quoted, this would have given a much better indication of the frequency capability of the output stages.

Secondly, the lag compensation as introduced by the .0022uF capacitor could have been implemented, with the inherent advantage of less high frequency distortion, by simply applying feedback to the base of T7 by a suitably dimensioned capacitor from the collector of T10.

R. Tymerski
Fairy Meadow, NSW

Limited space prevents us from reproducing Mr Tymerski's calculations, so let us deal with each point he has raised in the order that they occur. First, at least he agrees that T11 and therefore T13 is voltage driven. That conclusion is more clearly recognised if T11 and T13 are regarded as a Darlington equivalent with an Ft roughly equivalent to that of T13 alone. So far, so good. Well, T12 and T14 should also be regarded as a Darlington!

For those that disagree, we examine the output stages more closely. Referring to the "top half" of the output stage, the base of T14 "sees" a source impedance which is the sum of the collector load of T10 plus the series 270 ohm resistor divided by the beta of T11, all in parallel with the 68 ohm emitter resistor of T11. Assuming a beta for T11 of 100, the calculation is:

$$R\ (\text{source})\ \text{for T13} = \left(\frac{4700}{2} + 270\right)\frac{1}{100} \quad //68\ \text{ohms}$$

which has a result of 19 ohms (approximately).

So the base of T13 "sees" a voltage source with an output impedance of around 19 ohms or so (there are several simplifying assumptions here, the main one being that the beta of T11 is constant regardless of the current in the output stage).

Cowper Sheetmetal & Engineering, 11 Cowper Street, Granville, NSW 2142 are manufacturing the chassis, cover and front panel for the Playmaster Twin Twenty Five. The chassis and cover are finished in grey hammertone enamel while the screen-printed front panel is brushed aluminium. Note that the power transistors must be thermally connected to chassis so the enamel must be removed from the power transistor mounting areas. Reader enquiries should be directed to parts retailers.

By comparison, the situation with T14 is not quite so favourable. Here, the base of T14 "sees" the current source formed by the collector of T12, in parallel with the 68 ohm collector resistor of T12. Since a current source has a very high output resistance, the source resistance seen by the base of T14 is effectively 68 ohms. Admittedly, this is not quite as favourable as the condition for T13. But we stand by the original statement. T11 and T12 are voltage driven, and so are T13 and T14.

While the source impedance seen by T14 is 3.5 times higher than that for T13, in practice there is no appreciable difference in maximum slew-rate between negative and positive excursions of the output signal. This is because the slew-rate limit is imposed by the lag compensation applied to T10. No advantage can thus be gained, as far as symmetrical slew-rate limiting is concerned, by making the output stage fully complementary.

In any case, PNP power transistors such as 2N5873 are not quite as rugged, as far as second breakdown is concerned, as is the 2N3055. Nor is it as cheap, or as readily available in large quantities. This last consideration was very important in the design otherwise shortages would have limited the supply of kits.

Returning to the letter: Yes, the 500kHz open loop bandwidth before lag compensation is applied is the small signal frequency response. When lag compensation is applied, slew-rate limiting imposes the power bandwidth limitation at about 100kHz. Relatively few commercial amplifiers can match this.

As far as the lag compensation is concerned, it may appear crude but it gives the most predictable result and a better stability margin than the compensation method proposed by Mr Tymerski. And as noted above, it defines the slew-rate limit for the amplifier as a whole, as well as the open loop frequency response.

Moving now to the second letter:

Five errors I have noted which have not so far been referred to by you. Only the first presents any real query.

(1) The .0022uF capacitors in the circuit diagram between collector T10 and the O volt line appear on the PC layout on the collector of T9.

(2) The chassis wiring diagram does not show a lead from OV line to frame of headphone socket which needs to be insulated from the panel. If bolted to the chassis direct the .047uF capacitors on the speaker terminals are shorted out. Why were two .047's specified here as they are in parallel?

(3) The metal faces of the BD139/140 must face the opposite way to that referred to in the article (page 59, May issue).

(4) Of no importance—the 1k resistors and .001uF capacitors between the collectors of T1 and T2 are reversed on the PC board as well as the compensation components referred to in the Errata note of the June issue.

(5) Again of no importance—auxiliary inputs 1 and 2 are transposed on the circuit diagram as they are third and fourth switch positions respectively.

E. Rogers

Bellerive, Tasmania.

Here seems to be the appropriate place to make an apology to those readers inconvenienced by the errors in the articles. The error in the text concerning the orientation of the BD139/140's has perhaps caused the most confusion. The correct orientation of the driver transistors is clearly shown in the centre photograph on page 67 of the May 1976 issue.

As far as AC signals are concerned, the order of resistors and capacitors in a series network is of no importance, as Mr Rogers has indicated. In a similar way, the .0022uF capacitor is actually connected to the collector of T10 by virtue of the 0.1uF capacitor shunting T15. Thus, while the capacitor is physically connected to the collector of T9, the constant current stage, its effect is to roll off the high frequency response of T10.

The earth return for the headphone socket is via the chassis. Purists may care to insulate the headphone socket and run a separate earth return back to the power supply earth on the PC board. While the two .047uF capacitors may appear to be in parallel, they are isolated at supersonic and radio frequencies by the inductances of the leads involved. They are meant to bypass RF interference picked up by the loudspeaker earth returns.

Now to answer the final letter in this article:

With regard to the amplifier circuit, the base currents of T6 and T7 are supplied through 22k resistors from the OV line. This means that the bases will be negative (−200mV) with respect to the OV line. The polarity of the 22uF capacitors should therefore be reversed from that indicated on the diagram.

Nor should the power amplifier inputs be directly connected from the balance control but through a capacitor. Otherwise both the offset voltage and the quiescent current in the output varies with the balance control setting. As

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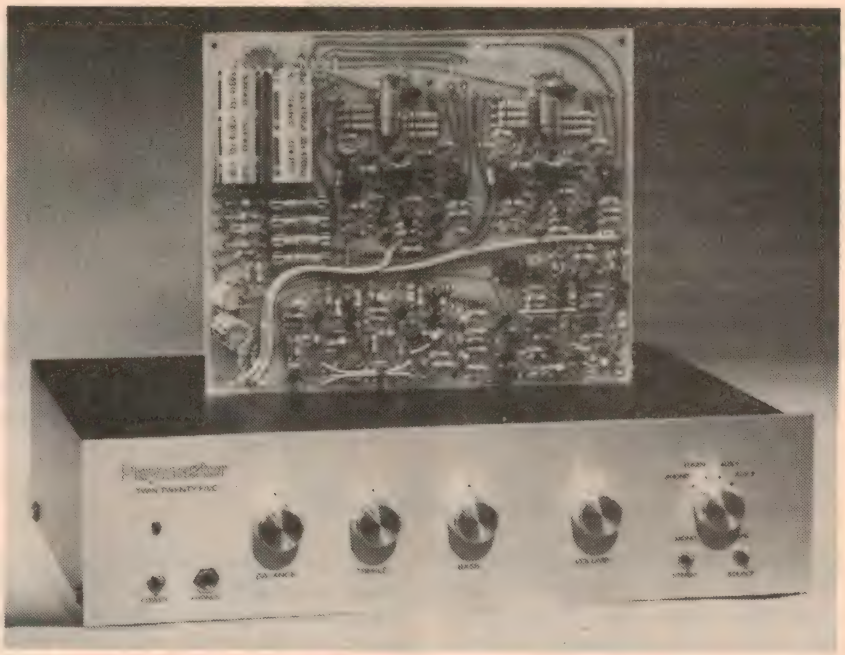


Applied Technology Pty Ltd, 109-111 Hunter Street, Hornsby, NSW 2077 have announced the availability of several kit versions of the Playmaster Twin Twenty Five plus a fully assembled version. Also available is a timber case to match a tuner kit marketed by Applied Technology Pty Ltd.

The assembled amplifier shown above has a chassis which is slightly larger than our prototype. It is made of cadmium-plated and passivated steel while the wraparound cover is black Marviplate. The front panel is 10-gauge aluminium with a "natural" scratch-grain finish while the five milled knobs have a matching finish.

We understand that a comprehensive assembly and instruction manual is in preparation at the time of writing. An inspection and repair service is also available.

Price of the basic kit is $85 and with a pre-assembled PCB (as shown above) $10. The fully assembled and tested version is $115. All prices exclude freight and packing.

refinements I have put in an adjustment for the emitter resistor of T8, to permit complete control of the initial offset voltage and a zener controlled 12V supply to D1 and D2 to hold the currents in T8 and T9 very constant so that the offset voltage and quiescent current are more insensitive to supply variations.

Also, while running final tests into 8-ohm loads, I found that with the volume control at maximum and with an oscillator connected to both phono inputs, there was instability before clipping. This instability was a relaxation type. The trouble lay in the 680 ohm resistor. Reducing it to 470 ohms gave complete stability.

E. Blackwood.
Mosman Park, WA.

Thank you for bringing the reverse connection of the 22uF feedback capacitors to our notice. Since the polarising voltages are so small it is perhaps advisable that tantalum capacitors should be used here. Readers who have experienced the instability mentioned may also care to reduce the 680 ohm resistor mentioned to 470 ohms.

We agree that the offset voltage (and therefore the offset current via the loudspeaker) is dependent on the balance control setting. However, this is not a problem as far as most loudspeakers are concerned. There will be a problem only within those loudspeakers which employ transformers, eg, Quad electrostatics and the B&W DM6.

Here, the primary winding of the loudspeaker transformer may have a very low DC resistance. Combined with the offset voltage of the amplifier it would cause a higher than desirable DC offset current to flow, with consequent heating of one of the output transistors in each channel. It may also have undesirable effects on the transformer itself.

In these cases, therefore, it is desirable to minimise the offset voltage. Before this can be achieved, the balance control must be isolated by a suitable tantalum capacitor (0.47uF or larger) in series with each power amplifier input, as suggested by Mr Blackwood.

We do not concur with the other modifications.

Two parameters determine the offset voltage at the output of the amplifier. They are the degree of matching of the beta of T6 and T7 and Vbe voltages of these two transistors. Of the two, the former parameter is dominant. Therefore, the simplest method of minimising the output offset voltage and the one which requires no modifications to the circuit, is to closely match T6 and T7 for beta. It should be possible to achieve an offset voltage of 20mV or less by this method.

If a lower offset voltage is required, some method of adjustment must be incorporated in the circuit. However we are reluctant to suggest modifications to the circuit.

One method of adjustment would be to have the emitters of T6 and T7 connected together via a 470 ohm preset, potentiometer with the wiper connecting to the collector of T8 via the 4.7k resistor. However, while this would be relatively simple to implement, we hesitate to recommend this method as it will reduce the open loop gain and thus the amount of applied feedback.

Another method involves connecting a voltage divider across the two 30V supply rails with the midpoint (the wiper of a potentiometer) connected to the base of T6 via the 22k bias resistor. This method has the drawback that it is impractical to implement on the existing PC board. Hence our leaning towards the suggestion of matching the transistors T6 and T7.

DICK SMITH KIT HAS 16-PAGE MANUAL

Dick Smith Electronics Pty Ltd have submitted for review a sample of their kit for the Playmaster Twin Twenty Five. A major feature of the kit is the well written assembly instruction manual. This has detailed photographs and instructions for key steps in the assembly process. Pictorial diagrams of all the semiconductors are included to help minimise confusion in insertion of these components.

Perhaps the most worthwhile feature of the manual, from the point of view of many would-be constructors, is the "sorry Dick it doesn't work" return coupon. For a fee of $10 the PC board and output transistors can be returned if the hobbyist is unable to obtain correct operation of the amplifier.

The kit arrives neatly packed in a cardboard carton with ample packing in the form of recycled paper (crumpled newspaper) to prevent components from being damaged. The transformer is bolted into place in the chassis while the other components are grouped and packed in plastic bags. Adequate amounts of shielded cable and ribbon cable are provided. There is even a small sachet of heatsink compound for the output transistors.

The chassis is cadmium plated and passivated steel while the wrap-around cover is black Marviplate. The front panel is 10-gauge aluminium with a champagne-coloured anodized "scratch-grain" finish. The milled aluminium knobs have a matching finish. The front panel is supplied with a protective plastic skin which prevent scratches during assembly. The PC board is fibreglass with the component overlay screen-printed on top.

While we did not assemble the kit it appeared to be complete in every detail. All components are of good quality and there were no substitutions for the semiconductors specified. This may not always be the case because some components are occasionally in short supply.

Full marks to Dick Smith and staff for the effort involved in putting together this kit and the instruction manual.

The Signetics 2650

We continue our survey of microprocessor chips and systems with this article, which takes a more detailed look at the Signetics 2650 device and its currently available evaluation kits. Although a relatively recent entry into the market, the 2650 has a particularly powerful instruction set and very flexible interfacing requirements. It seems likely to become the preferred 8-bit device for general purpose microcomputers.

by JAMIESON ROWE

The Signetics 2650 is an 8-bit microprocessor which is made using well proven N-channel MOS technology. It runs from a single +5V supply, which tends to simplify power supply requirements. All inputs and outputs are TTL compatible, and the chip requires only a single-phase clock signal input. As the chip operates in static mode, there is no minimum clock frequency.

With the original 2650 chip, the maximum clock frequency was 1.25MHz, giving instruction cycle times of from 4.8 to 9.6 microseconds. However, the currently available 2650-1 chip is rated to operate up to 2MHz, reducing the instruction cycle times to the range 3.6 – 7.2us.

The broad architecture of the 2650 chip is shown in the block diagram below. It uses an 8-bit bidirectional data bus, and a separate 15-bit address bus. This gives a direct addressing range of 32,768 bytes (32k), arranged in four pages of 8,192 bytes.

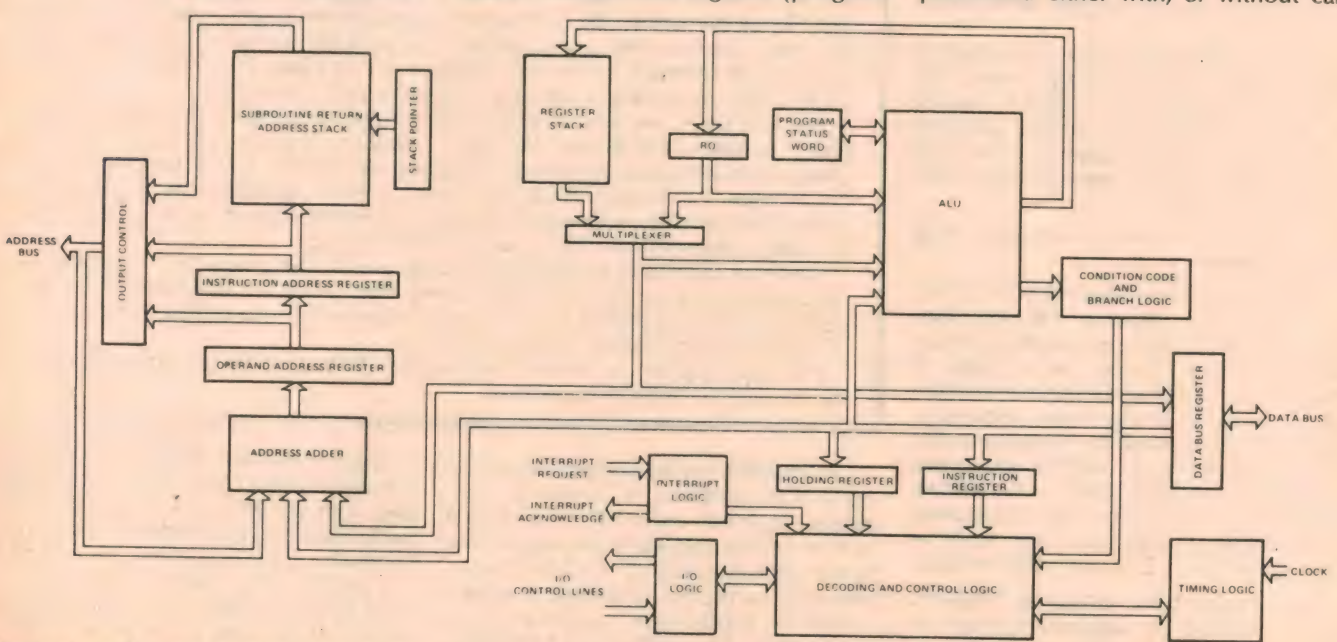
There are seven 8-bit addressable general purpose registers, one of which is the accumulator R0. The remaining six make up the register stack, and are arranged in two groups of 3 selectable by one of the bits in the Program Status Word register (PSW).

Apart from the register stack there is a subroutine return address stack, consisting of eight 15-bit registers. This allows storage of up to eight return addresses, and hence provides for up to eight levels of subroutine nesting. (A nested subroutine is a subroutine itself called by a subroutine.)

The arithmetic and logic unit (ALU) performs arithmetic, logic and shifting functions. It operates on 8-bits in parallel, and uses carry-look-ahead logic. A second adder is used to increment the instruction address register (program counter), and also to calculate operand addresses for the indexed and relative addressing modes. This separate address adder, together with the separate instruction address and operand address registers allows complex addressing modes to be implemented with no increase in instruction execution time.

The PSW is a special purpose register which contains status and control bits. The PSW bits may be tested, loaded, stored, preset or cleared using instructions which affect the PSW. Three of the bits act as the pointer for the return address stack; two others act as a "condition code" register, which is affected by the results of compare, test and arithmetic instructions and may be used by conditional branch instruction; other bits store overflow, carry, the selection bit for the two register groups, an interrupt inhibit bit, a carry enable bit, a logical/arithmetic compare select bit, and flag and sense bits for external bit-serial interfacing.

It has been said that the 2650 has the most minicomputer-like instruction set of any microprocessor currently available. There are 75 basic instructions, but many of these are actually subdivided into a number of variations. For example the eight arithmetic instructions may be performed either with, or without car-



The basic architecture of the 2650 microprocessor chip showing major data, address and control paths.

ry/borrow; this also applies to the two rotate instructions. Similarly the four compare instructions may perform either arithmetic or logical comparison, while four of the 12 branch instructions and six of the ten subroutine branch/return instructions are conditional upon the two PSW condition code bits—giving typically about 3 possible variants.

Also although there are nominally only six input-output transfer (IOT) instructions, as distinct from the memory reference instructions (which may also be used for IOT), two of these are "extended" instructions which may address any one of 256 distinct 8-bit input-output ports.

One, two and three-byte instructions are used, giving a high degree of programming efficiency. Register-to-register and simple IOT instructions are one byte, extended IOT instructions are two bytes, while memory-reference instructions are either two or three bytes long as required.

The memory reference addressing modes provided by the 2650 are generally agreed to be the most extensive and versatile of any micro-processor currently available. The modes are as follows:

1. Immediate addressing, with the data mask or value in the second byte of the instruction itself.
2. Direct addressing, either absolute or program relative with a displacement range of from −64 to +63.
3. Direct indexed addressing, absolute.
4. Direct indexed addressing with auto increment.
5. Direct indexed addressing with auto decrement.
6. Indirect addressing, either absolute or program relative with a displacement range of from −64 to +63.
7. Indirect addressing with post indexing.
8. Indirect addressing with post indexing and auto increment.
9. Indirect addressing with post indexing and auto decrement.

Memory and IOT interfacing of the 2650 is asynchronous, using "handshaking" control signals. This makes the 2650 compatible with almost any type of memory and peripheral device.

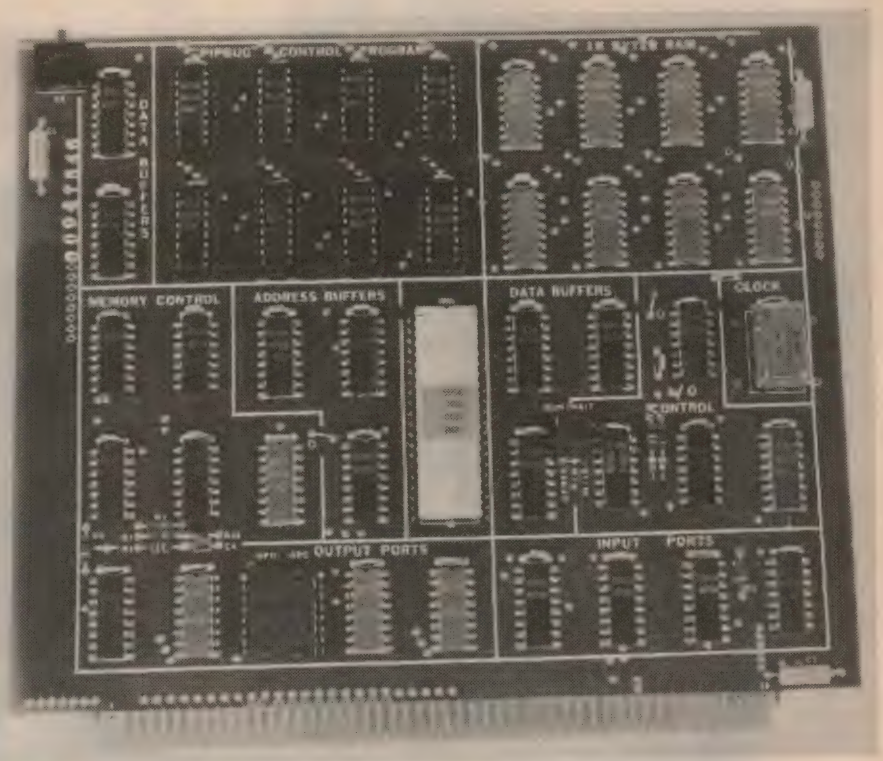
The 2650 has a single level vectored interrupt capability. When it enters the interrupt mode, the chip is able to input an 8-bit address vector via the data bus. This may be used with either direct or indirect addressing to access interrupt servicing routines in any part of the memory space.

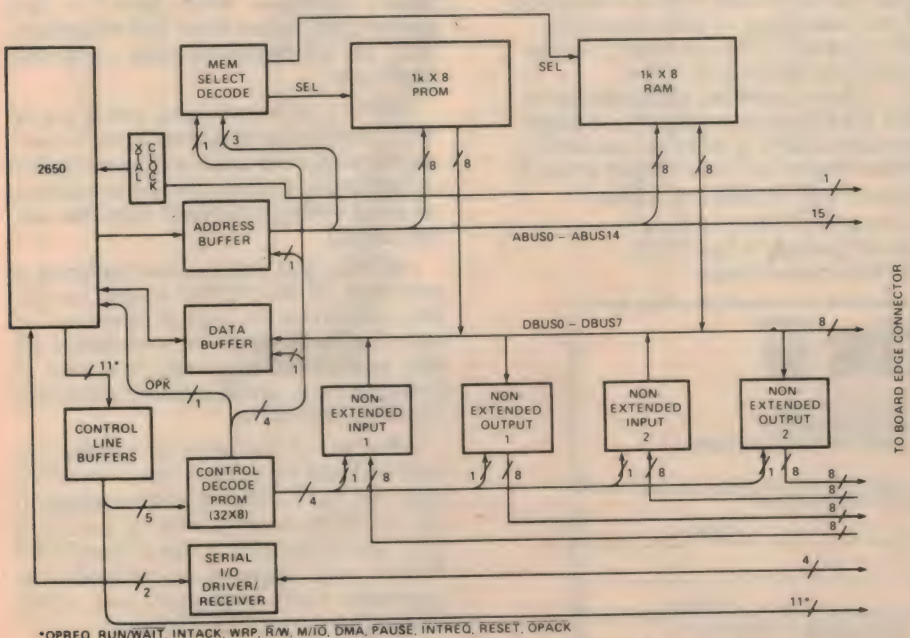
As you should be able to see from this brief rundown of its salient features, the 2650 is a particularly flexible microprocessor, and one which is very well suited for general-purpose microcomputer applications. As such it would seem a good choice for anyone seeking to build up a minicomputer-type system based on a microprocessor.

At the same time, the relatively low cost of the basic chip (currently around $20) and its ability to operate with little more than a clock generator and a ROM in dedicated mode would also make it a good choice for low level applications.

Signetics make two evaluation kits based on the 2650, and these are currently available in Australia from Philips. The more elaborate of the two is the PC1001, which comes as a ready-wired PC board together with edge connector socket and literature. The other kit is a little less elaborate, and comes as either a completely wired PC board or as an assemble-it-yourself kit. In wired form it is designated the PC1500, while the D-I-Y version is the KT9500.

Both kits are basically small microcomputers, capable of being used directly with a power supply and an ASCII





The PC1001 evaluation board system, which is also pictured at top of this page.

teleprinter to develop small 2650 programs in machine language. They could also be expanded into quite pretentious minicomputer systems, by adding further memory and IOT facilities.

An add-on RAM memory board is in fact available, and is directly compatible with either kit. Designated the PC2000, it provides an additional 4k bytes of memory.

At the time of writing this article, we have only had the opportunity to examine and use one of the PC1001 evaluation kits. This is on a PC board measuring 203 × 175mm, with a 100-way double sided edge connector along one of the longer sides. The PC board is pictured, and as you can see there are quite a few IC's apart from the microprocessor.

In fact the PC board is a three-layer assembly, with copper conductors sandwiched in between two layers of epoxy-fibreglass as well as on the two external surfaces. This has allowed Signetics to fit a surprisingly large amount of circuitry on the relatively modest PCB area.

On the PC1001 board is 1k bytes of RAM, capable of storing quite a respectable user program. In addition there is another 1k bytes of ROM, containing a resident monitor-debug program which Signetics have dubbed "PIPBUG". This will be described shortly.

There is an on-board serial asynchronous teleprinter interface, which may be adjusted by means of wire links for either 20mA current loop interfacing or RS232-type voltage interface.

In addition to the teleprinter interface there are four 8-bit parallel IOT ports—two inputs and two outputs. These are wired to be accessed via the two-byte "non-extended" IOT instructions, so that small systems with four or less peripherals (apart from the teleprinter) may be implemented with no further hardware.

The PC1001 board has a 1MHz crystal clock, and therefore is immediately compatible with a 110-baud teleprinter (serial formatting is done by firmware routines, so baud timing is derived from the system clock).

Full data and address bus buffering is provided on the PC1001 board, to simplify addition of further memory or peripherals. All of the control signals are also available at the edge connector in buffered form, which again simplifies any required interfacing.

Although at the time of writing we have not had the opportunity to examine and use the PC1500/KT9500 evaluation kit, we understand that this is based on a PC board identical in size to that of the PC1001. And although the second kit is nominally a less pretentious one, it still offers quite impressive facilities.

For example it still provides 1k bytes

of ROM, with the same resident monitor-debug program (PIPBUG) provided on the PC1001. The only difference in terms of on-board memory is the RAM, which in this case is of only 512 bytes. This is still adequate for a lot of modest programming, of course—and you can always add further memory, as the board again provides fully buffered data, address and control signal buses.

The serial asynchronous teleprinter interface is still provided, but there are now only two 8-bit parallel IOT ports. However, these are programmable in terms of direction, so that they may be used for both input and output.

In place of the crystal clock, the PC1500/KT9500 has an R-C clock oscillator using a 74123 dual monostable.

As not all of the PC board is used by the basic circuitry of the PC1500/KT9500 system, the unused area is provided with plated through holes on 0.3in centres, to allow fitting of additional memory/peripheral decoding ICs if desired.

In short, the PC1500/KT9500 evaluation kit is only a little less flexible than the PC1001. Both are in reality small development systems, capable of being used to develop and run 2650 programs. And in their basic form, each could be used to develop programs for running on the other—apart from the memory size difference. In that sense they are software compatible.

Not only this, of course, but because they use the same resident monitor-debug program they are also virtually identical in the operating sense.

As evaluation kit resident debug programs go, PIPBUG seems quite a flexible one. It recognises seven basic commands, each of which consists of an alphabetic character, any required numerical parameters, and a terminating carriage return. The parameters are given as hexadecimal characters, with leading zeroes unnecessary.

The seven commands and their functions are as follows:

A – See and alter memory
B – Set breakpoint (2 permitted)
C – Clear breakpoint
D – Dump memory to paper tape
G – Go to address, run
L – Load memory from paper tape
S – See and alter registers

The D command may be used to punch out any desired range of memory locations, with leader, checksum and trailer to facilitate reloading. Both the A and S commands may be auto-incremented, by terminating with a line feed instead of a carriage return.

A full listing of PIPBUG is provided with the evaluation kits, which is very useful. Among other things, it allows the user to make use of the teleprinter servicing subroutines in PIPBUG, by arranging for application programs to call them as required.

```
 SIMPLE ANSWER-BACK PROGRAM FOR SIGNETICS PC1001 SYSTEM
DEVELOPED BY J.ROWE,"ELECTRONICS AUSTRALIA" MAGAZINE 11/7/76
NOTE: PROGRAM STARTS AT LOCATION 500 (HEX)


LISTING:

500   76 C0      PPSU     40    /SET UP TTY
502   3F 02 86   BSTA,UN CHIN   /FETCH CHAR FROM TTY VIA PIPBUG RTN
505   C1         STR2,R1        /SAVE
506   3F 02 B4   BSTA,UN COUT   /ECHO VIA PIPBUG ROUTINE
509   01         LOD2,R1        /RESTORE IN R0
50A   A4 0D      SUBI,R0 "CR"   /R0= CHAR -CR
50C   58 74      BRNR,R0 -12    /CR? IF NOT KEEP GOING
50E   04 0A      LODI,R0 "LF"   /SUPPLY LF
510   3F 02 B4   BSTA,UN COUT
513   05 00      LODI,R1        /SET R1=0
515   0D 25 26   LODA,R1 526+   /FETCH ANSWER CHAR
518   C3         STR2,R3        /SAVE
519   3F 02 B4   BSTA,UN COUT   /PRINT
51C   A7 0D      SUBI,R3 "CR"   /R3= CHAR -CR
51E   5B 75      BRNR,R3 -11    /CR? IF NOT KEEP GOING
520   04 0A      LODI,R0 "LF"   /YES; SUPPLY LF
522   3F 02 B4   BSTA,UN COUT
525   1B 5A      BCTR,UN -38    /BACK TO LOOK FOR NEW INPUT
527   47 4F 20                  /START OF ANSWER BUFFER
52A   41 57 41
52D   59 2C 49
530   27 4D 20
533   42 55 53
536   59 21 0D                  /ANSWER MUST END WITH CR (HEX 0D)


SAMPLE OF OPERATION:


*G500

HELLO THERE, WHAT AT PRESENT ARE YOU COMPUTING?
GO AWAY,I'M BUSY!

DON'T BE LIKE THAT,PLEASE
GO AWAY,I'M BUSY!
```

This simple novelty program was written largely to verify that the teletype servicing routines in PIPBUG could be called by a user program. The listing shows instruction mnemonics and comments as well as the actual instructions in hexadecimal code.

To illustrate this, the author wrote a simple novelty program for the PC1001 system. Its listing and a sample of the operation are reproduced on these pages, and as you can see it does nothing more than monitor input from the teleprinter, waiting for the person at the keyboard to press the carriage return key. When this occurs, it responds by typing out a curt reply: "GO AWAY, I'M BUSY!".

I wrote this little program mainly for practice with the 2650 instruction set, and also to check out the use of the PIPBUG teleprinter servicing routines. The program inputs characters via the "CHIN" subroutine in PIPBUG, whose calling address is 0286, and outputs characters via the "COUT" subroutine whose calling address is 02B4. As you can see the program itself starts at location 0500.

Note that the program uses one, two and three-byte instructions, and requires only 57 bytes of memory including the answer message buffer. This illustrates the programming efficiency possible with the 2650's powerful instruction set and wealth of memory addressing modes.

If you're interested in the PC1001 or the PC1500/KT9500 evalution kits or the PC2000 add-on memory, they are available from the Electronic Components and Materials Division of Philips Industries, with offices in each state, or from their distributors. Prices for the kits are as follows:

PC1001 – $345 plus tax
PC1500 – $245 plus tax
KT9500 – $165 plus tax
PC2000 – $400 plus tax

Each of the basic kits comes with all of the literature needed to use it. All you need is a power supply and a teleprinter. The teleprinter must communicate in ASCII code, as with most other kits. Here at EA we are currently working on a way to allow this to be done at low cost using a surplus Baudot teleprinter.

Simple power supply for microprocessor systems

Many of the microprocessor development systems and evaluation kits now becoming available require dual power supplies. Rather than tie up variable bench supplies, it is usually more convenient to use a dual fixed-voltage supply which can be "dedicated" to the job. The simple supply described here has been designed with this in mind.

by JAMIESON ROWE

When we first started to work with microprocessor evaluation kits and development systems a few months ago, the easy way to get them "up and running" in the shortest time was to power them from one or more variable bench supplies. However it soon became apparent that this was not the ideal long-term approach.

For one thing, bench supplies have a habit of disappearing when one's back is turned! Like most development labs, ours never seems to have enough bench supplies, and as a result any supply which is not actually in use on one bench tends to be "borrowed" and taken to another.

In itself, perhaps, this is no more than an inconvenience—one can always retrieve the supply or supplies when the "borrower" makes the mistake of turning his or her own back! What tends to be more of a problem is that inevitably the supplies have been adjusted to different voltage and current settings, so that one then has to go through all the steps of resetting them for the system you are working with.

Quite apart from the problems arising out of "borrowing", there is still the consideration that very often one wants to retain a microprocessor system in the "power up" state for hours at a time, in order to retain a program in the RAM. With most simple systems there is no standby battery supply to maintain the RAM when the main power is removed, and only systems costing thousands of dollars have magnetic discs with automatic "save memory" facilities.

The only alternative with simple systems is to dump out the RAM contents on to paper tape or magnetic cassette, and then load them back in again next time the system is powered up. This can be very tedious and time consuming; hence the attraction of being able to keep the system powered up for reasonable periods of time.

A simple and low cost way to allow this to be done is to make up a fixed-voltage power supply which can be "dedicated" to running the microprocessor system, freeing bench supplies for other uses. This is the approach we have taken, and so far it has worked out well—so well, in fact, that we thought readers might find the supply of interest.

Even if you are a home enthusiast and don't have a problem with "borrowing", you may still find it convenient to build up a supply like ours. If nothing else, it will free your bench supply or supplies for other things—and few hobbyists have all that many bench supplies! If you don't have a bench supply, or don't have enough to run the microprocessor system of your choice, then you will hopefully find the supply even more attractive.

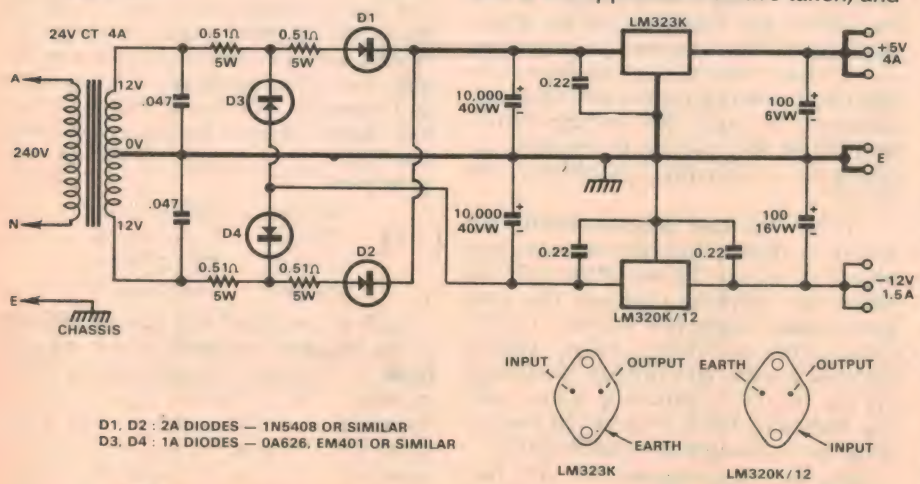
Our supply was designed around parts we had on hand, and because of this it may not be the most elegant design solution. But it works well, and would be an entirely practical proposition if you don't fancy designing one yourself from scratch.

Just about all of the microprocessor evaluation kits and development systems currently available require either a single +5V supply, or a +5V supply and a −12V supply. We have therefore designed the supply as a dual unit, to supply these two voltages.

The +5V supply current requirement is usually somewhat higher than that for the -12V supply, and our supply has been designed with this in mind. The +5V supply will deliver just on 4 amps, while the -12V will deliver about 1.5 amps. In both cases the output is well regulated against both line and load variations, and ripple is typically less than 10mV P-P at loads of 3A and 1A respectively.

As you can see from the circuit, there is nothing particularly special about the supplies. They share a common power transformer, which has a centre-tapped 24V winding rated to supply at least 2A per side. We used a Ferguson type PF 3788, which is actually rated to supply 4A per side, and it accordingly runs almost cold. There is a similar transformer made by A & R, type PT7311. However you could probably get by with a transformer of lower rating, such as the A & R type PT5509 or the Ferguson type PL30/60VA.

Both supplies use full-wave rectifier circuits connected across the transformer secondary. The positive supply uses a pair of 2A diodes, such as the 1N5408 or similar, while the negative supply uses a



D1, D2 : 2A DIODES — 1N5408 OR SIMILAR
D3, D4 : 1A DIODES — 0A626, EM401 OR SIMILAR

E4 DUAL POWER SUPPLY FOR MICROPROCESSOR SYSTEMS

2/PS/—

pair of 1A diodes such as the 0A626, EM401 or similar.

Each end of the transformer winding is bypassed to ground via a .047uF capacitor to reduce mains transient leakthrough. A 0.51 ohm 5W resistor is also connected in series with each end of the winding, to limit switch-on surge current through the diodes. An additional pair of resistors with the same value are used in series with the positive supply rectifier diodes, to make the rectifier output droop at high currents. This is to reduce the power dissipation of the voltage regulator IC, enabling it to deliver maximum current.

Identical reservoir capacitors are used for both supplies, with a value of 10,000uF. We used two high-grade "computer quality" units which were on hand, and rated at 40VW. However any units rated at 20VW or more would be suitable. For the negative supply you might well be able to use a smaller capacitance value without degrading performance unduly. A value of 4700uF or even 3300uF may be adequate, particularly if you do not anticipate needing the full 1.5A current capacity.

Both supplies are regulated using 3-terminal IC regulators. The positive supply uses an LM323K, while the negative supply uses an LM320K/12. Both of these are in the TO-3 flange-mounting "power transistor" metal package, and are mounted on 100mm square finned heatsinks to limit temperature rise during extended operation.

Each device is fitted with 0.22uF metallised polyester ("greencap") bypass capacitors at its pins to ensure stability. The LM323K requires one between its input pin and common, while with the LM320K/12 it is advisable to fit two—one at the input and one at the output. Each supply is provided with a 100uF electrolytic across the output, to improve transient response.

As you can see from the photograph, we built up the supply on a long narrow chassis salvaged from an earlier project. The power transformer was mounted at one end, with the two large electros mounted in line at the centre flanked by the finned heatsinks for the two regulator ICs. The ICs were actually mounted near the bottom of the heatsinks, to allow for the possible addition of "booster" transistors at some later stage. The transformer terminations, rectifier diodes and protective resistors were mounted beneath the chassis on a length of miniature resistor panel—apart from the mains cord termination, which was made via the recommended screw terminal strip ("B-B" connector).

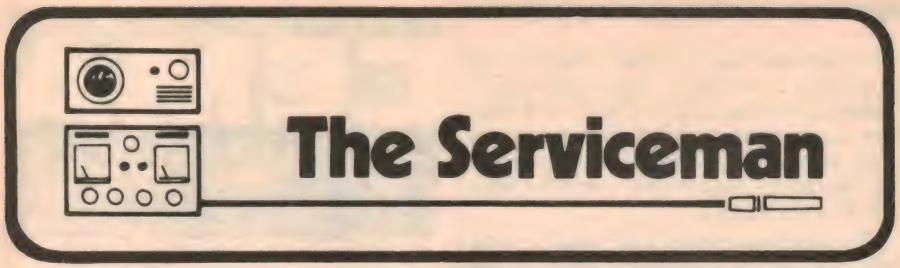
The outputs from the supply were taken to a screw terminal strip on the top of the chassis, at the end remote from the power transformer. Our strip was eight connectors long, so we allocated three each to the two "active" outputs and two to the earth or "common".

An important point: note that whereas the common connection to the LM323K regulator is brought out to the case, this is not so with the LM320K/12. Here the case is the input terminal, and the common connection is one of the two pins. So that although the case of the LM323K may be mounted directly on the heatsink without insulation, the LM320K/12 must be insulated with the usual washer and plastic bush arrangement. In both cases it is a good idea to use a smear of silicone grease to ensure a good thermal bond.

Our prototype supply was built up on long, shallow chassis. Note the heavy wire used for the 5V/4A supply wiring, to minimise voltage drop.

As mentioned earlier, this supply should be suitable for just about all of the microprocessor systems currently available. To our knowledge there are only two exceptions: the Fairchild and Mostek kits, based on the F8 chip set. Both of these require a +12V supply, as well as the basic +5V supply.

To make the supply suitable for either of these kits, you will need to convert the present −12V supply to one of opposite polarity. This is not difficult to arrange, as follows. Reverse the polarity of D3 and D4, the 10,000uF reservoir electro and the 100uF/16VW output electro. Then in place of the LM320K/12 negative regulator, use an LM340K/12 positive type. This has the same connections as the LM323K, and only requires a single 0.22uF stabilising capacitor between input and common. As the case is common, you won't need to insulate it when mounting. That's basically all there is to it.



TV problems in a difficult area

Last month I presented some typical day-to-day service stories, related to me by a colleague, in an effort to assess the colour TV service scene as it is at the moment. This month I have some comments from another colleague, but one who is faced with somewhat greater problems.

This colleague works on the south coast of NSW, in the area served by channels 4 (commercial) and 5A (national). TV reception in this area is not without its problems. Long distances are often involved, creating fringe area conditions. This is aggravated by the hilly—and sometimes mountainous—terrain or, on the seaboard itself, by salt spray which plays havoc with aerials and feeders.

As a result, he has built up a wealth of experience in solving difficult problems which the city serviceman seldom has the opportunity to experience. In the coming months I hope to persuade him to pass on some of these experiences for the benefit of my readers. (And I shall undoubtedly learn a point or two myself.)

Here is his first story.

This story concerns a colour TV set which had been purchased from me about 12 months ago. It was a well known brand, capable of a very good performance in most respects but, in my opinion, not really suited to this customer's requirements. The customer's location is well to the south of the stations, and tucked in under a hill.

This set, on the other hand, is not famed for its fringe area performance and would not have been my choice. In fact, some cheaper sets would have been much more suitable. Still, "the customer is always right", so the set was duly delivered and installed.

During the installation process I went to a lot of trouble to get the best result. The old monochrome aerial was rebuilt and the area surveyed with the field strength meter for the best signals. It turned out to be a real battle to get a good signal and, in fact, the best I could do was about 200uV on the vision carrier of each channel—a figure which is normally regarded as barely adequate.

When the set was finally installed the picture was undoubtedly noisy but the customer was highly delighted and said he had never seen a better picture. And, while I may have smiled inwardly, it would be hardly diplomatic to question his opinion.

At the end of the 90 day warranty period I made a courtesy call to see how the set was going, and whether they had any problems. I checked the performance briefly, touched up the static convergence, and went on my way basking in the good will of the customer. And that was the last I heard of it until a couple of weeks ago, when I received a plaintive phone call.

The complaint was no colour on channel 5A. My first question was whether the fine tuning was correctly adjusted. In most cases where there is loss of colour on only one channel it is due to incorrect fine tuning, which means a trip of several miles out into the country to do nothing more than adjust the fine tuning control.

But the customer was adamant. The fine tuning control had been varied over its full range, but there was no colour on 5A. Frankly, I still had my doubts, but there was nothing for it but to visit the set and find out. Sure enough it was as the customer said; no colour on 5A, normal colour on channel 4, and no amount of fine tuning would cure the problem.

Feeling that it was unlikely to be a fault in the set, the field strength meter was hauled out and connected to the aerial lead. A common cause of trouble in this area is loss of signal due to salt deposits on the aerial and feeder, it being right on the coast. Even with all possible precautions, such as open wire feeder, etc, it can still give trouble.

The field strength meter showed that channel 4 signals were very similar to those recorded at the time of installation; a fraction lower perhaps, but nothing to worry about. But channel 5A was another story. The vision carrier signal was actually up on the previous figure—over 250uV— presenting an apparent contradiction.

Previous experience suggested that this called for a check on the sound carrier level. Tuning the field strength meter to this frequency produced a surprising result; a mere 10 to 15uV.

Well, at least that provided a partial explanation for the lack of colour, and more or less exonerated the set. And, if it wasn't the set, it had to be the aerial. First I studied aerial as best I could from the ground through binoculars—a very useful addition to the tool kit in any area using high aerial masts!

This revealed nothing obvious, so out came the ladder and the whole aerial and feeder system was gone over with a fine tooth comb. The result was completely negative; as far as I could see there was nothing wrong with the aerial or feeder.

On the other hand it was quite obvious that something had happened since the set was last checked, whereby the channel 5A signal had deteriorated. Had this happened suddenly or had it been gradual? Careful questioning of the customer suggested that it may have been coming on for some time. They had noticed lack of colour periodically on 5A over a period of some months, but had been inclined to put it down to transmission faults.

It seemed almost certain that it was an aerial fault but, as a final check, I brought in another set, well known for its high sensitivity, and tried it on the same aerial. It proved its superiority by bringing up the 5A picture in colour, but the picture was still far from satisfactory.

So that was it; in one sense or another I had an aerial problem. Either the aerial had deteriorated in some manner not immediately obvious or there had been some change in the signal path whereby the aerial was now inadequate for that location.

The most important question was what to do about it. Clearly a better aerial was needed, but this was easier said than done. One of the problems of this area is that the channel combination, 4 and 5A, is unique in Australia. As a result, there is a relatively small demand for aerials in this combination and the aerial manufacturers are unwilling to incur the cost of developing high performance aerials for such a limited market.

This has proved to be such a serious problem in this area that I had already done something about it as a sort of part time activity. More particularly I had considered the feasibility of developing a 16 element phased array, cut to suit channels 4 and 5A.

So, after digging out some old text books and getting to work with a calculator, I came up with a set of figures from which I built an experimental version. This was then compared with several commercial aerials and the results were very encouraging.

The aerial was cut to resonate at about 116MHz which was felt to be a good compromise between channel 4 (94-101MHz) and 5A (137-144MHz). This figure was arrived at partly by calculation and partly by experimental trimming.

Subsequently I discovered that this figure was very close to that used by commercial manufacturers.

Having produced such an aerial, and tested it as extensively as possible on a short-term basis, it seemed that this was the golden opportunity to give it the ultimate test. So, with the customer's permission, the commercial aerial was taken down and the experimental aerial erected in its place.

With the new aerial installed, the set was switched on and the moment of truth awaited. Sure enough, up came channel 5A in full colour. After the initial enthusiasm the field strength meter was brought out again to check just how much difference it had made.

The channel 4 readings were similar to those obtained with the previous aerial. The channel 5A vision carrier had dropped a little, while the sound carrier had risen to between 50 and 60uV; a much more satisfactory figure.

(Editorial note: The sound to vision power ratio of Australian TV stations is 10 to 1, having been changed from 5 to 1 in 1972 in anticipation of colour TV and to improve the compatibility of monochrome receivers. On this basis the voltage ratio of the two signals will be the square root of 10; 3.16 approximately. Assuming equal aerial efficiency at both frequencies, a vision carrier of 250uV should be accompanied by a sound carrier strength of approximately 80uV.)

In most respects it was a story with a happy ending. There was no doubt that the customer was happy, and I was reasonably happy that the problem had been solved. Also the experimental aerial seemed to be coming up to expectations. What I was less happy about was the absence of a clear cut reason for the problem in the first place. As far as I could see there had been no significant change to the building line between the set and the transmitter, or anything else that could alter the signal strength. So for the moment it remains a mystery.

A rather more important aspect of the story is that it provides a clear demonstration of the need for field strength meter readings in fringe areas and, even more important, the need to check both sound and vision carriers.

This provides a check on the bandwidth of the aerial system; something which, with the advent of colour, has become all important. In a monochrome system lack of bandwidth results only in loss of fine detail which, undesirable though it may be, is often overlooked by the average viewer. But, with colour, the same situation can so attenuate the 4.43MHz colour sub-carrier that colour reception just is not possible.

And no customer is going to overlook that situation!

Still on the aerial theme, here is another story emphasising just how difficult things can be in an area like this. Once again it involved the sale of a colour TV set, followed by the installation of an aerial system.

After the sale was completed and while I was making arrangements to install the aerial, the customer explained that he would be at his present address for only about two months. After that he hoped to move into his own house which was under construction. On this basis, and since he lived in a strong signal strength area, I made a mental note that a simple aerial installation would probably suffice.

Strength was added to this decision when I came to do the actual installation. It was a foul day; raining cats and dogs, blowing a miniature gale, and a heavy sea pounding the nearby beach. By the time I reached the customer's front door I had no doubt that a simple aerial system would be adequate!

I fitted a suitable bracket to the bargeboard, clamped a small 4/5A aerial and mast to it, and ran about 12ft of ribbon along the bargeboard and in through a convenient window. A check with the field strength meter confirmed my judgement, showing about 2.5mV on each channel. The set produced a good clean picture and, having shown the customer how to twiddle the knobs, I went on my way.

That was the last I heard of the system for about three months. Then, on another wet and miserable day, the customer phoned to say that the set was not performing very well, and would I come and have a look at it. From some preliminary questioning I gathered that performance was particularly bad during wet weather.

By the time I fitted the call into the day's rounds the rain had stopped, the sun was out, and it was a warm and pleasant day. Even so, one look at the picture was sufficient to indicate that it was definitely snowy; not at all the kind of picture one expects from 2.5mV.

Sure enough, a field strength meter reading showed only a couple of hundred microvolts. Strange! What would cause a drop from 2.5mV to 200uV in only three months? And this was after the system had had time to dry out. When it was raining the picture would sometimes vanish completely.

I was afraid I knew the answer, surprising and unpleasant though it may have been. The ribbon had succumbed to the salt spray. There was nothing for it but to replace it and, as the customer indicated that it would be several more months before he could move into his new home, it would be foolish to tempt fate a second time.

So out came the old ribbon and in went the trusty open wire feeder. And Hey Presto! Back to a healthy 2.5mV and a first-class picture. The moral of the story is that, in no circumstances, even for a short term temporary installation, should black ribbon feeder be used in seaside areas, even where the signal is quite healthy.

Protect your home from intruders:

Simple burglar alarm has pulsating output

This burglar alarm system has enough audio output to wake a sleeping person or, alternatively, can be used to control a more powerful noise maker powered by a separate battery. With suitable contacts and/or sensors, the applications can range from monitoring liquid levels in tanks to the protection of medicine cabinets.

by J. GRANDIN*

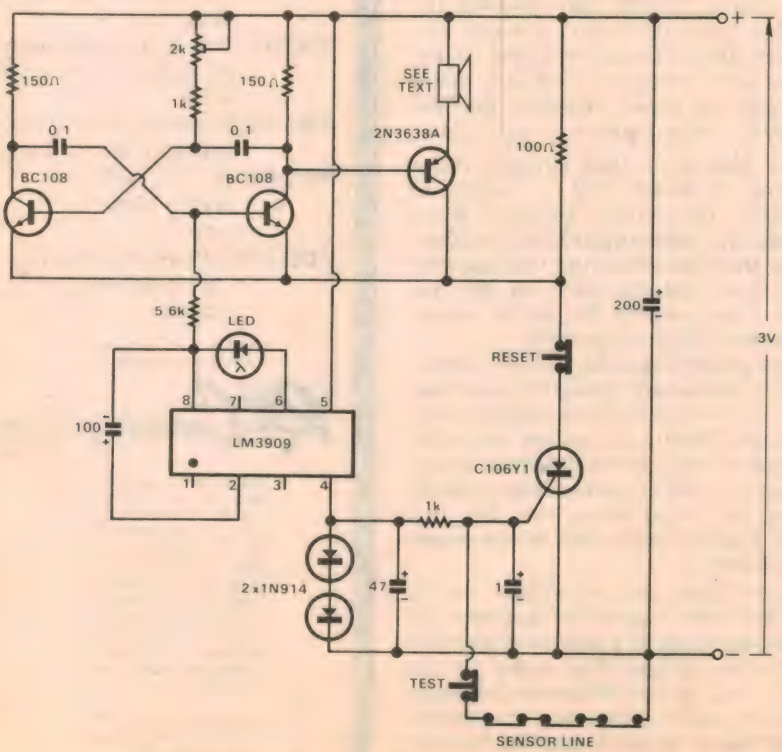
*155 The Boulevarde, Strathfield, 2135.

The audio output of the alarm system described here is of a pulsating nature with an alternately rising and falling frequency. The sound is quite distinctive (and irritating), and certainly attracts attention.

Two popular "D" size cells are used to power the unit and these will last for many months as the idle current is only 0.7mA. Should the alarm be activated, then the current will rise to 70mA, giving some hours of audio output.

When the unit is switched on, a flashing LED (rate about 2 flashes per second) gives a positive indication that the unit is functioning. Should the light output be dim and the flashing rate slow, then this is a warning that the cells need replacing. In addition, a test button is provided that activates the alarm as a further check that the system is operative. As the alarm will continue to sound even though the test button is released, a reset button is provided.

The unit is one that the author feels will have a wide number of applications, eg, monitoring the opening of doors and windows, and even the gate of the swimming pool fence! Suitable alarm sensors, such as reed switches, conductive tape, mercury switches, etc, are available from firms specialising in security systems.



VERSATILE ALARM SYSTEM

3/MS/

Refer now to the circuit. An LM3909 IC is used as a basic flasher unit with a 100uF capacitor connected between pins 2 and 8 to give the desired flashing rate. The return to the negative supply is via two silicon diodes bypassed by a 47uF tantalum capacitor and a 1k resistor via the sensor line.

The sensor line normally shorts the gate of the SCR (a C106 low voltage type) to the cathode, which is also connected to the 3V negative. It will be noted that the sensor line also normally shorts out the 1uF tantalum capacitor connected from the SCR gate to cathode.

These steps are necessary to ensure that the SCR fires only when the sensor line goes open circuit, and the following paragraph gives the reasons.

When the LM3909 discharges the 100uF capacitor and causes the LED to flash, a short burst of current from the supply flows through the IC (see Electronics Australia, July 1975). If this fast rising burst of current is fed directly to the sensor line, then it will be found that the impedance of the line can be high enough to fire the SCR, even though the line is a closed circuit. The writer found that a line of 40 feet made up of ordinary lighting flex would cause the SCR to fire.

As it stands, the two silicon diodes, together with the 47uF capacitor, develop sufficient pulse voltage to trigger the SCR when the sensor line goes open circuit. The 1uF capacitor across the gate of the SCR is an additional measure to ensure protection against any transients that may be picked up by the sensor line.

When activated by an open circuit in the sensor line, the SCR completes the supply for the audio side of the system. Note that a 100 ohm resistor is provided to give a satisfactory "holding current" for the SCR over the usable range of supply voltage. As the audio section is a mul-

Above is the prototype unit made up by the author. Layout is not critical.

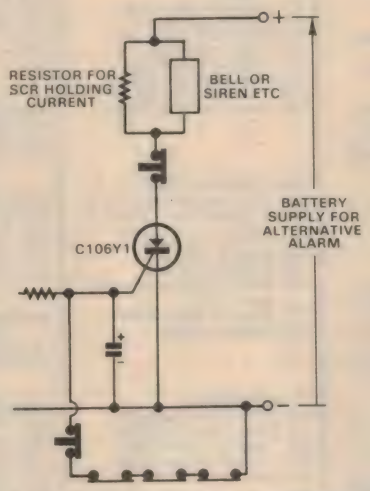
tivibrator, the SCR would otherwise switch off as the multivibrator switches from one state to the other.

Although the multivibrator at first sight may seem to be symmetrical, this is not the case. The second BC108 has its base fed via a 5.6k resistor from the negative side of the 100uF capacitor of the flasher circuit. This negative side becomes less positive as the capacitor charges, so changing the multivibrator frequency. The discharge of this capacitor carries the negative side of the capacitor more negative than terminal "4" of the LM3909. The base of the second BC108 is also brought more negative by this discharge action, and results in the pulsating characteristic of the multivibrator.

The emitter follower drives the speaker by a series of pulses and these pulses will excite any resonances in the speaker and baffle system. Normally these resonances are to be avoided or at least reduced by suitable damping, but in this application they can be made to give a more strident note to the alarm signal. The purpose of the 2k trimpot in the collector of the first BC108 is to alter the mark space ratio of the multivibrator so as to reinforce these resonances.

It is here that the characteristics of the speaker become important. Obviously, the more sensitive the speaker, the greater the output. The writer has tried speakers from Rola 4F to 8M and, as might be expected, the larger and more sensitive the speaker, the greater the output. However, this statement needs some qualification. A 5 x 3 in 15 ohm speaker of good sensitivity gave as good a result as a 4 ohm 6 in speaker. The small 8 ohm speakers as used in personal portable radios were not satisfactory.

If considerable output is required, then the alternative circuit can be used where a separate supply can power a siren or



Alternative ciruitry for installations requiring higher acoustic output.

bell system. Either the self-contained audio system or separately powered audio source can be used with different sensor methods. For example, a light dependent resistor can be used in place of the 1k resistor feeding the gate of the SCR. The degree of light necessary to fire the SCR can be set by a resistor from gate to cathode. Obviously this light sensor can be used in conjunction with the contact sensor line so that there will be two SCRs in parallel.

For liquid levels a mercury switch on a float arm can be used to check for either too high or too low a liquid level.

For heat sensor applications, metal alloys are available that will melt as low as 149°F. This particular alloy is made up as follows: 50% bismuth, 25% lead, 12.5% tin, 12.5% cadmium. Thus, heat sensors can be combined with contact sensors to provide a wide range of protection conditions, or can be employed separately.

Circuit & Design Ideas

Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Improvements to 200MHz digital frequency counter

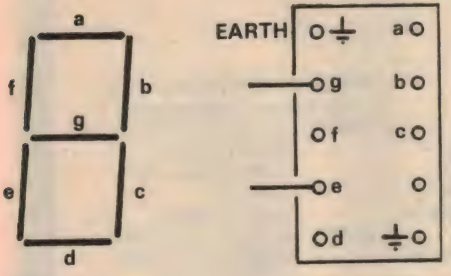


FIG. 1

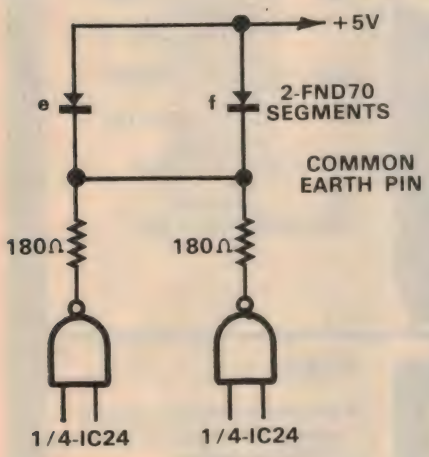


FIG. 2

Since the 200MHz Digital Frequency Counter was published in December, 1973, I am sure that very many of these useful instruments have been built. For this reason, perhaps some readers may be interested in modifications which I have incorporated in the one which I made.

I was not satisfied with the appearance of the two LEDs used as the "½" digit and I found that it was a practical proposition to use another FND70 for this purpose. It is possible to glue this display to the preceding one as it will just fit in past the end of IC24. As the spacing is narrower, I used segments f and e (see Fig. 1) for the "1", which gave a very acceptable appearance.

All the pins were cut short, except the earth pin, which can be soldered in the position vacated by the anode of the upper LED, and the two pins for segments e and f which were bent outwards and soldered via a jumper to the position left by the anode of the lower LED.

One problem was that the LEDs were used in the common anode configuration, whereas the FND70s are common cathode. This was overcome by a simple rearrangement of the circuit (see Fig. 2). A simple rewiring of the 180 ohm resistors is all that is needed to complete the modification. Wiring LEDs in parallel may not be technically ideal but with the closely matched ones in the FND70s it seems to work out all right.

On the higher ranges under some conditions, I found the blurred last figures (caused by the rapid strobe rate) to be disconcerting. I assembled a simple two IC circuit as shown in figure 3 onto a piece of Veroboard. Only four connections are required, one each to earth and the 5V rail, the input line to IC4 (pin 8), while the output goes to IC2 (pin 11).

On the circuit shown on pages 42 and 43, the new circuit is inserted in the "T" line between the output of IC4 and the common line of IC20-23. Two links must

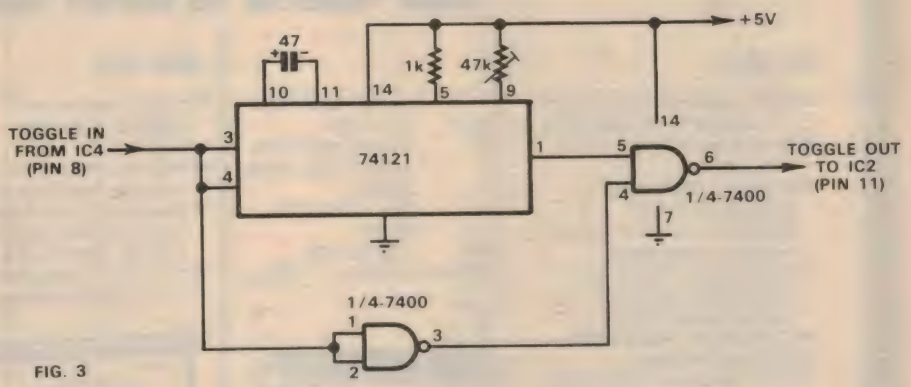


FIG. 3

be removed, the short one between IC4 (pin 8) and IC2 (pin 11) and the long one between IC4 (pin 8) and IC20 (pin 3) and replaced with a jumper from IC2 (pin 11) to IC20 (pin 3). The 47k preset pot enables the strobe (or toggle) rate to be adjusted to any desired maximum level. I found three or four per second to be about right.

I found that it is also possible to increase the maximum frequency of the counter by a suitable choice of ICs for IC2 and IC4. I used a 74H10 for IC4, and I selected the best 7404 from six different brands. The 74H04 will not work satisfactorily in this position. I found considerable variation of the devices from different manufacturers. Although time has not permitted me to try them yet, the 74S series would probably be better still.

Also, careful adjustment of the 470 ohm resistor in the input shaping circuit is beneficial. I used 330 ohms and achieved a maximum frequency of over 30MHz, still with good sensitivity. Although I have not fitted the prescaler yet, it should extend to over 300MHz, as the 95H90 can in theory achieve this frequency.

(By Mr A. G. Briggs, 580 Lowe Street, Hastings, New Zealand.)

Linear volts to frequency converter

In many situations it is desirable to control linearly the output frequency of a 555 timer circuit by adjusting a potentiometer or an input voltage. In the conventional astable configuration of the 555, the timing capacitor discharges and charges through one or two timing resistors. Thus the frequency is inversely related to changes in the timing components, and is also inversely related to changes in the control voltage.

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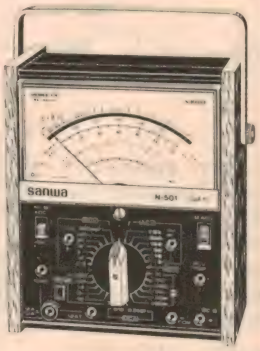
±DCA 0-2μS 0-0.03-0.3-1.2-3-12-30mA 0-0.12-0.3-1.2-12 (300mV) ±2%
ACV 0-3-12-30-120-300-1.2k (1MΩ) ±2.5% Freq. 20Hz to 50kHz (±1dB)
ACA 0-1.2-12A
Ω x1 x10 x100 x1k x10k x100k (max. 200M) Batt. 1.5Vx1 & 9Vx1
dB –20 to +63
252x191x107mm 1.95kg



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±DCV 0-0.3-3-12-30-120-300 (100kΩ) 1.2k (16.6kΩ/V) ±2% 30k (w/HV probe)
±DCA 0-12μA 0-0.3-3-30-300mA 0-1.2-12A (300mV) ±2%
ACV 0-3-12-30-120-300-1.2k (5kΩ/V) ±3% Freq. 20Hz to 1MHz at 3V
ACA 0-1.2-12 (300mV) ±3%
Ω x1 x10 x100 x10k (max. 50M) Batt. 1.5Vx1 & 9Vx1
dB –20 to +63
184x134x88mm 1.3kg

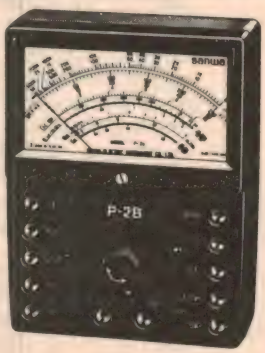
U–60D

- **Measurement ranges available.**

DCV 0.1 0.5 2.5 10 50 250 1000 (20kΩ/V) (25kV w/HV probe extra)
ACV 2.5 10 50 250 1000 (8kΩ/V)
DCmA 0.05 2.5 50 500 (500mV drop; 100mV for 0.05mA)
Ω Range – X1 X10 X100 X1k Midscale –50Ω 500Ω 5kΩ 50kΩ Maximum – 5kΩ 50kΩ 500kΩ 5MΩ Batteries 1.5V dry cell (UM-3 or equivalent) X2
LI 0.06mA 0.6mA
LV 3V 3V

LI 6mA 60mA
LV 3V 3V

- **Allowance.** Within ±3% f.s.d. for DCV & DCmA Within ±4% f.s.d. (±6% for 2.5V) for ACV Within ±3% of scale length for Ω
- **Size & weight.** 133X92X42 mm & 300 gr



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Ω 0-5k 500k Batt. 1.5Vx1
dB –20 to +36
MΩ 0.1–50) using
μF 0.0002–0.6) external power
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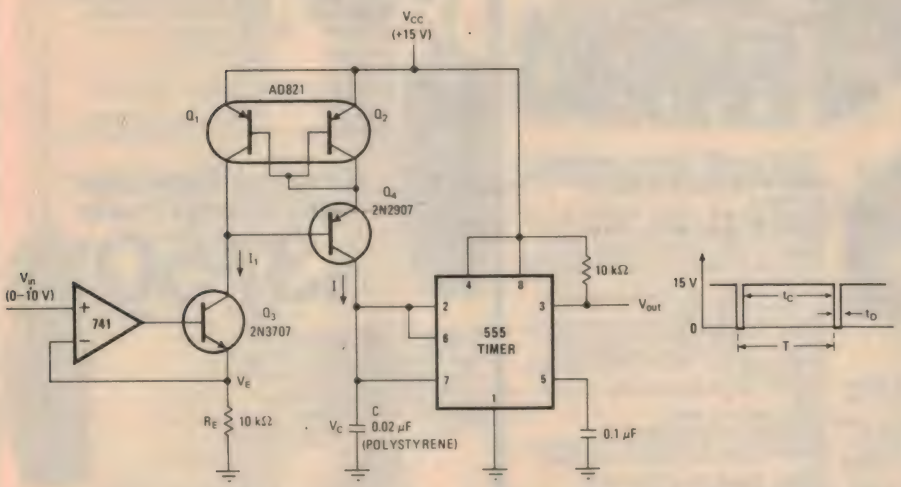


linear voltage-to-frequency conversion can be obtained from the 555 astable multivibrator circuit as shown. A voltage-dependent current I linearly charges the timing capacitor C so that output frequency increases linearly with the input control voltage V_{in}. During the charging phase of the cycle the capacitor voltage is given by:

$V_c = V_{cc}/3 + I_t/C$

Charging continues until V_c reaches $2V_{cc}/3$, making charging time t_c equal to $V_{cc}C/3I$.

At this point the capacitor rapidly discharges back to $V_{cc}/3$ through the ON resistance R_{ce} of the discharge transistor in the timer (pin 7). The discharge time, t_d, is approximately equal to $0.69R_{ce}C$.

The circuit is designed to make t_c much greater than t_d, so the period T of the multivibrator is very nearly equal to t_c and the frequency f becomes:

$f = 31/V_{cc}C$

The 741 operational amplifier and transistor Q3 form a voltage-dependent current source.

To allow the input voltage V_{in} to be referenced to ground, the capacitor is actually charged by current I from the current mirror formed by Q1, Q2 and Q4 that makes I equal to I_1. The transistor Q4 functions in a modified cascode configuration to increase the output impedance of the current source and increase the tracking of I_1 and I. Substituting V_{in}/R_e for I in the frequency equation gives:

$f = 3V_{in}/R_eCV_{cc}$

For a maximum input control voltage of 10V and the parameters used, the charging current can be easily varied over a range from 10uA to 1mA, and the output frequency in Hz is given by:

$f = 10^3V_{in}$

The experimentally obtained frequency and accuracy are within 2%. At high frequencies (10kHz) the non-zero discharge time (t_d) becomes significant and tends to make the frequency less than the predicted value. At low frequencies (100Hz) the decreased transistor betas and bias currents of the comparators (pins 2 and 6) decrease the voltage-to-current conversion factor and tend also to make the frequency less than the predicted value. This latter error may be compensated for to some degree by adjusting the offset of the 741 so that $V_e = V_{in} + 1.5mV$. This has the effect of increasing the conversion factor at low input voltages without seriously affecting the accuracy at larger input voltages. Here this technique reduces the error in the 100Hz region to less than ± 0.4%.

For higher frequency operation (1-100kHz), it is better to reduce capacitor C to 0.002uF, rather than decrease R_e, otherwise the ratio of t_d to t_c would become too large and errors would result at the high end of the frequency range.

(By Andrew McClellan, in "Electronics".)

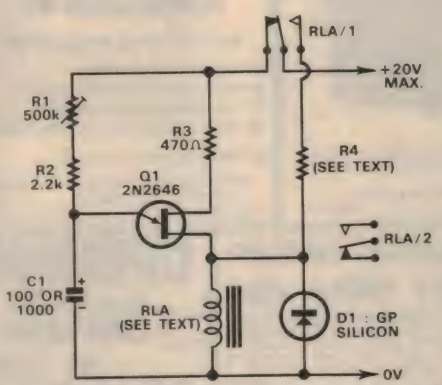
Relay time-delay circuit

Originally this relay time-delay circuit appeared in 110 Semiconductors Projects (for the Home Constructor), by R. M. Marston, page 64. I have built up the circuit as shown and I found it to work very well.

R1 was a 500k variable but I substituted a fixed resistor of 330k. The value of R4 should be such that it limits the current from the supply rail to a suitable value for the relay winding. In my case, this was set to 270 ohms. Where the original circuit called for a 100uF, or 1000uF electrolytic capacitor for C1, I used a 50uF.

The above values resulted in a delay time of 30 seconds. A higher value for the 330k resistor would give a longer delay time. The relay which I used was a 6V, 52 ohm coil, type No 21/2CA, made by Davall. For D1 I used a type 1N4004 diode.

(By Mr. G. Hubley, 154 Waterloo Street, Tuart Hill, WA 6060.)



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Circuitry: 19 transistors, 14 diodes, 1 zener diode, 1 varistor. **Channel Controls:** 23 – all crystals supplied, On/Off/Volume, variable squelch, PA/CB switch, Delta tune, ANL channel selector.
Jacks & Connections: External antenna, microphone, external speaker, DC power 13.8Volts (EIA)
RECEIVER: Receiving system: Dual conversion superheterodyne with mechanical filter. **Sensitivity;** 0.5uV at 10 dB(S+N)/N **Selectivity;** +– 10kHz 60dB **Spurious Rejection;** 50dB **PA/Audio Output Power;** 4Watts. **TRANSMITTER Modulation.** High level **RF Input power;** 5Watts.
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Sensitivity: AM– 0.5uV for 10 dB (S+N)/N. SSB– 0.25 for 10 dB (S+N)/N.
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SPECIFICATIONS

Dimensions	50 x 250 x 76 mm
Weight	680g
Semiconductors	11 transistors, 1 IC, 8 diodes
Frequency control	Crystal
Channels	2 channels (1 channel fitted)
Receiving system	Crystal-controlled superheterodyne

1Channel Transceiver with 300mW Power

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SPECIFICATIONS

Dimensions	50 x 250 x 76 mm
Weight	640g
Semiconductors	10 transistors, 1 IC, 7 diodes
Frequency control	± 800Hz
Channels	1 channel – 27.24 MHz
Receiving system	Crystal-controlled superheterodyne

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12 Volt Soldering Iron Model FS30, 15 watts

This fantastic little iron operates from any 12 volt AC or DC source (car or boat battery or 12 volt Transformer). Complete with plated tip & 14ft lead.
Cat. T1910 ..... $3.90
Cigarette lighter plug to suit 50c
Spare tip to suit only 50c

GENERAL PURPOSE PREAMP

STOP PRESS

SEE E.T.I. 445 JULY 1976

ONLY $7.50

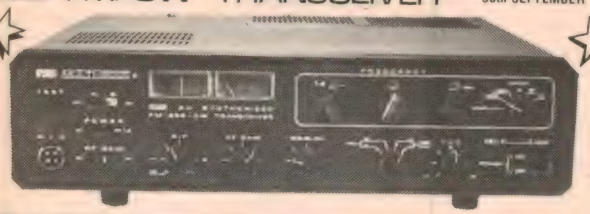
Single PCB – Only ONE IC. Supplied with PCB pins. Runs on 10V to 40V DC. Complete with all parts for —
1 – Magnetic Preamp (RIAA)
2 – Tape Preamp (NAB)
3 – Microphone -40-55 or 80dB gain.
Cat. K-3427.. .. .. $7.50

SPECIAL FOR THIS MONTH

NOW ONLY $550. NORMALY $585. SAVE $35.

MULTI-2000-A SSB/FM/CW TRANSCEIVER

THIS SPECIAL IS ONLY AVAILABLE ON ORDERS DATED PRIOR TO THE 30th SEPTEMBER 1976

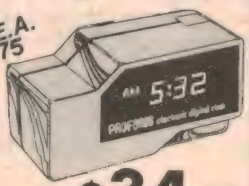


MULTI 2000A TRANSCEIVER

The ultimate in 2M equipment, operates on FM, SSB, CW. Tranceives between 144.0 and 148.0 MHz in 10kHz steps. Fully synthesised repeater offset. 4 fixed channels (crystals not included) high and low power, noise blanker, wide and narrow band switch etc. Sensitivity FM : 1.0uV, SSB/CW : 0.3uV. RF output : 1W and 10W (PEP). Built in power supply for 240 volt AC or ext. 12 volt DC. Cat. D-3010 .. .. $585.00

HIGH QUALITY

see E.A. nov. 75



$34.50

PROFORDS FANTANTASTIC ALARM CLOCK KIT

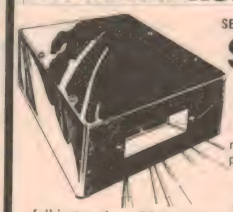
AN INCREDIBLE CLOCK, THE DC8 HAS EVERYTHING

* HUGE 10mm FLURO READOUT
* BRIGHT DISPLAY HOURS, MINUTES, AM, PM
* ELECTRONIC ALARM TO THE MINUTE
* 7 MINUTE SNOOZE CYCLE * 240 Volt OPERATION
★ MODERN CASE AND FILTER PANEL

SIMPLE ENOUGH TO BE MADE BY A BEGINNER
Cat. K-3340.. .. KIT VERSION $34.50
Cat. X-1050..FULLY BUILT & TESTED.. .. $37.50

RADAR INTRUDER ALARM

SEE E.T.I. MAY 1975



$57.50

This sophisticated unit uses microwaves to detect any movement within a 10 metre range by the Doppler principle. Uses Philips "Solid State" Gunn diode radar module, 3 IC's and 2 transistors. Kit is supplied with full instructions, PC Board and diecast case. Operates from mains power or 12V D.C. Beam even passes through timber.
Cat. K-3270.. .. .. $57.50

VIDEOLYMPIC TV GAME

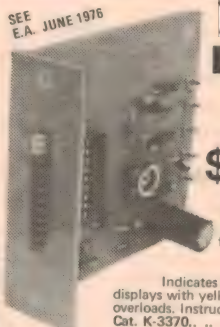
$49.50

SIMILAR UNITS WERE $99.50

HUNDREDS SIMILAR UNITS SOLD at $99.50

PLAY YOUR OWN TV GAMES TONIGHT AT LESS THAN HALF THE COST AS PREVIOUSLY OFFERED. *NOW ONLY $49.50.* Just plug into the aerial terminal of your TV set. Play such games as Tennis – Catch Ball – Traps Shooting – Solo.
Cat. X-1125.. .. .. $49.50

SEE E.A. JUNE 1976



NEW LED VU METER

$11.95

Latest solid state way to check levels. Uses 12 LED's. Much faster than moving coil meters for checking peaks overloads etc. Indicates ALL transients. Green displays with yellow & red to indicate overloads. Instructions supplied.
Cat. K-3370.. .. .. $11.95

OPENING SOON IN MELBOURNE & BRISBANE

LOOK FOR THE OPENING OF MY TWO NEW STORES IN MELBOURNE AND BRISBANE. NOW OUR INTER–STATE CUSTOMERS CAN HAVE THE SAME INSTANT SERVICE AS THE N.S.W. ENTHUSIASTS !
THE ADDRESSES ARE SHOWN BELOW.

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(PARK IN THE BOULEVARD)

SHOP HOURS
MON – FRI : 9 to 5.30
SAT: 9 to 12

bankcard welcome here

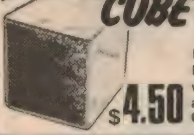
POSTAL CHARGES

ORDER VALUE			CHARGE
$5	to	$9.99	$1.00
$10	to	$24.99	$1.50
$25	to	$49.99	$2.50
$50	to	$99.99	$3.50
$100 or more			$5.00

BY COMET FREIGHT : THE MINIMUM PACKING AND HANDLING CHARGE IS $1.00. WE DESPATCH "FREIGHT-ON" AND YOU PAY WHEN YOU RECEIVE THE GOODS.
FOR C.O.D. SEND $2.40 EXTRA PLUS $3.00 DEPOSIT.
MINIMUM MAIL ORDER AMOUNT IS $5.

SALE

VINYL COVERED CUBE SPEAKER



Ideal extention speaker. Handsome complete unit with 4" speaker. Buy now and SAVE well over $ 2.00

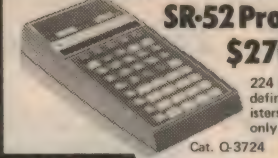
$4.50

Cat.A2457 .... $4.50

texas=calculators PLUS

SR-52 Programmable

$270tax free $299.98 Inc. Tax.



224 Program locations, twice the user defined key , twice the memory registers, BUT HALF THE COST of the only other programmable in its class.

Cat. Q-3724

Pssst! 'ERE MATE

'AVE A CAPTAIN COOK AT THIS LITTLE BEAUTY! WOULD YOU BELIEVE FM, YES – THE FULL FREQUENCY FLAMIN' MODULATION BIT FOR ONLY

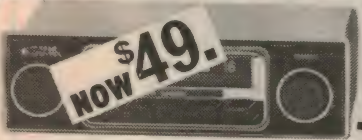
a lousy $12.50

She's got the lot; easy to read tuning dial, large dynamic speaker, built in ferrite aerial for AM (AM too?) telescopic aerial for the you beaut FM, battery, ear phone and wrist strap to impress ya sheila!

Cat. A-4364 .. .. Tell 'em DICK sent ya! $12.50

AM/FM POCKET RADIO

CAR RADIO VALUE !



NOW $49.

~~$79.00~~

IDEAL LONG RANGE RADIO AT AN ECONOMICAL PRICE

This unit works on 12 volt negative earth and has 8 transistors for powerful reception. Five push buttons lets you preset 5 of your favourite stations and also you have manual tuning for all other stations. Five watts of solid power goes well with 5" round 4 ohm speaker that is INCLUDED with the radio as a separate feature. Aerial not supplied.

Cat. A-5980.. .. .. $49.00 ~~$79.00~~

$ 84.95

NOVUS

NATIONAL SEMICONDUCTOR 4640 SCIENTIFIC

An advanced highly accurate calculator with 54 functions for professionals and students in engineering, math, physics and the sciences.

Cat. Q-3257 – $84.95 Tax Inc. $77.19 Tax Free

650 MATHBOX

This inexpensive calculator features 4 function operation, fixed 2 place decimal point, 6 digit LED readout. Cat. Q-3200 $8.95 Tax Inc. $8.16 Tax Free. $8.95

THE GREATEST YET!

AM/FM MULTIPLEX TUNER

only $34.50

What you see is what you get – no assembly required. Specially produced for Australian conditions. Has built in antenna for AM and beautiful airspaced AM/FM tuning gang covering full Australian AM/FM bandwidth. Operates from 12Volts @ 22mA.

FM SENSITIVITY 3.5uV; IF REJECTION 80dB; IMAGE REJECTION 52dB; STEREO SEP'N 25dB

Cat. F-4615..$34.50

CAR CASSETTE STEREO

UNPARALLELLED – UNIQUE – DISTINCTIVE

Uses famous Belgian Starr tape mechanism. Slider controls for volume, tone & balance. Has button for instant eject as well as fast forward and reverse. Gives healthy 4 watts output per channel into 4 ohms with a frequency response of 100 - 8,000 Hz. 47 x 130 x 161 mm.

Cat. A-6485 Unit Only – Speakers Extra $79.

$79.00

OUT THEY GO!

ONLY $24.61 TAX FREE

FORDS SCIENTIFIC CALCULATOR

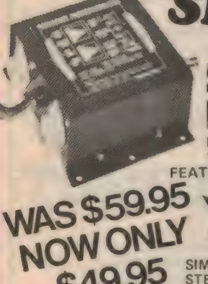
$27.50 Inc. Tax

LAST YEAR WE WERE SELLING THIS REMARKABLE CALCULAT OR FOR $59.00. UNBEATABLE VALUE AT THIS LOW PRICE!

Cat. Q-3010 Tax Free $24.61

SPECIL CAR STEREO POWER BOOSTER

SAVE $10 ZAPPY!



BOOST YOUR CAR STEREO POWER TO 10 WATTS PER CHANNEL.

FEATURES:
- *Fits any 12Volt Negative Earth Car
- *Universal Impedance
- *Full Stereo Amplifier
- *Output 10 Watts Per Channel
- *Suits any Car Stereo Set.

Cat.A-6610........................$49.95

WAS $59.95 NOW ONLY $49.95

SIMPLY CONNECT UNIT BETWEEN CAR STEREO AND SPEAKERS AND HIDE IT UNDER THE DASH.

SOMEBODY GOOFED!

NOW WE'RE OVERSOCKED WITH FAMOUS Garrard

Model CC10A AUTO Record Changer

SPECIAL VALUE

These high quality British made turntables have AUTO record play from a stack or MANUAL or AUTO single play or REPEAT. Each changer comes complete with full installation and operating instructions.

HONESTLY – we are overstocked and they must be sold – so YOU BENEFIT AT THIS REALLY AMAZING LOW PRICE.

REMEMBER! THESE ARE TOP QUALITY PLAYERS.

*Play up to 8 records, 78, 45, 33, 7", 10", 12". *Play single records. *Reject or single repeat. *Switch off and reset automatically. *Compact to suit portable.

Cat. A-3068.. **only $19.75**

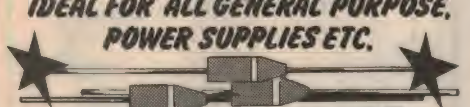
LOOK! FANTASTIC 3AMP DIODE OFFER

FULLY BRANDED·STC MADE

DS-5402 200VOLT MIN. AT 3AMPS

GIVES 6AMPS IN A BRIDGE

IDEAL FOR ALL GENERAL PURPOSE, POWER SUPPLIES ETC.



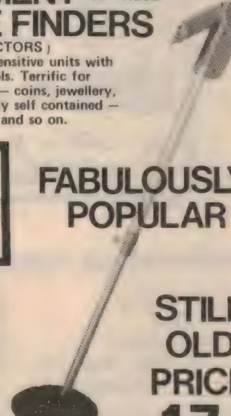
Cat. Z-3222 1-9 **30c** 10 UP **25c**

STRIKE ME LUCKY! YOU STRIKE IT RICH AGAIN!

WE HAVE JUST RECEIVED A NEW SHIPMENT OF THESE TREASURE FINDERS

(METAL DETECTORS)

They are powerful, highly sensitive units with finger tip adjustment controls. Terrific for locating all types of metals – coins, jewellery, electric wires etc. Completely self contained – no trailing wires aux. packs and so on.



FABULOUSLY POPULAR

STILL OLD PRICE

X-1062.......... $17.50

NEW SPECIAL

SEE E.T.I. AUG. 76.

JUST RELEASED

ETI 602 MINI ORGAN KIT

COMPLETE WITH TREMOLO SILVER PLATED FIBREGLASS KEYBOARD – TWO VOICES.

Cat. K-3430 (*Case NOT included*) ONLY $24.75

books VALUE

FOR AMATEURS BEGINNERS ENTHUSIASTS

NOVICE RADIO GUIDE

PERFECT FOR ANY BEGINNER!

Shows you how to build your station, operate it and how to get it licenced.

Cat. B-2280 .. .. **$4.75**

ELECTRONICS FOR SCHOOLS

RECOMMENDED BY EDUCATION AUTHORITIES!

Ideal for teachers and students. Contains a special parts list and order form for all the components you need from DICK! This book could lead you to a great hobby or rewarding career.

Cat. B-3604 .. .. STILL ONLY **$4**

RADIO AMATEURS HANDBOOK

Latest edition of this standard reference book. Over 600 pages! Textbook, Data book, Construction manual! Good stocks now but they sell quickly so HURRY!

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THE PACE MICROPROCESSOR

NEW

Printed March '76 this is the most up-to-date guide to Programmed Equivalents to TTL Functions. Published by National Semiconductor it is an excellent introduction to the building and operation of MICROPROCESSORS.

Cat. B-4031.. **$6.90**

HUNDREDS MORE! SEE OUR 1976/77 CATALOGUE

SCOOP D.S.E. DRILL SPEED CONTROL

SEE E.A. JULY 76.

$9.75

This kit includes all the parts of the basic speed controller PLUS a small box with pre-punched and Marvi-plate front panel and complete instructions. Easy to build Makes your drill turn slow enough to be used as a screwdriver. E.A. Design.

Cat. K-3080.. .. .. $9.75

SPECIAL KIT PARTS

RE-4 Reverb Spring	*Used in Reverberation Kit*	Cat. X-1035	$9.75
UB-5 Zippy Box	*Used in TV Game Kit*	Cat. H-2755	$1.10
76/VG5 Printed Circuit Board	*Used in TV Game Kit*	Cat. H-8308	$5.50
76/M5 Printed Circuit Board	*Used in TV Game Kit*	Cat. H-8310	$1.50
74C00 CMOS Integrated Circuit	*Used in TV Game Kit*	Cat. Z-5410	$0.50
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76/R4 Printed Circuit Board	*Used in Reverberation Unit*	Cat. H-8314	$2.00
76/SA4 Printed Circuit Board	*Used in Twin 25 Amplifier Kit*	Cat. H-8302	$3.95
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Special LED Displays. 10 Green, 1 Yellow, 1 Red. Used in LED VU Meter		Cat. SEM5	$3.60
76/LM5 Printed Circuit Board	*Used in LED VU Meter*	Cat. H-8315	$2.00
76/S7 Printed Circuit Board	*Used in 650 MHz Prescaler*	Cat. H-8316	$2.50
76/EO4 Printed Circuit Board	*Used in 760 Organ Keyer Module*	Cat. H-8305	$3.20
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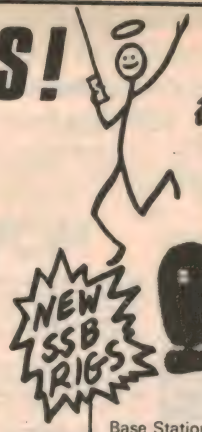
Peter Shalley has the greatest CB gear



Mobile Transceiver for 12 to 16 Volts D.C. Fully synthesized on all 23 U.S. C.B. Channels

Output: A.M. 4 Watts / S.S.B. 12 Watts } (not input to final)

Dual Conversion: P.E.P. Receiver: Power and S Meter. **Sensitivity:** less than .5 uv for 10db. **Transistors:** 36. Diodes & Thermistor 41 for use with Novice License.

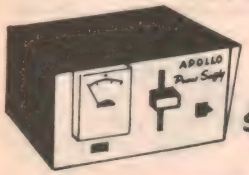
$199 P&P $5

Base Station dual Voltage 240V. AC or 12V. DC. Fully equipped with 23 American C.B. Channels.

Input to final: A.M. 8 Watts min. S.S.B. 25 Watts P.E.P.
Dual conversion: 7 I.F.Ts and 6 I.F. stages
Noise Blanker: Delta tune (Clarifier) +— 300 Hz.
Meter for, Signal in, R.F. out, S.W.R.
Sensitivity: .5 uv @ 6db **Size:** 33 x 13.5 x 24.5 cm. Wt. 7¾ kg. For use with Novice License.

$249 P&P $5

REGULATED POWER SUPPLIES

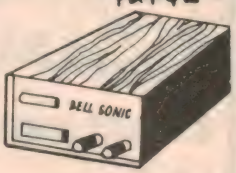


0–15 VOLT
$42 P&P $2

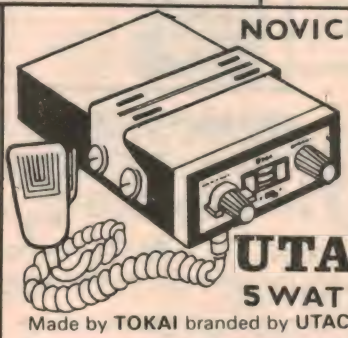
New model Adjustable Regulated Power Supply Delivers 3 Amps from 0 to 15 Volts. Meter shows Voltage and Amps. On/off switch. Perfect where flexibility is required. Ready to wire in.

12 volt
$29 P&P $2

Regulated power supply. Gives 12 Volts at 3 Amps Electronic O/load protection. Bezel light, on/off switch. Ready to wire in.



NOVICES



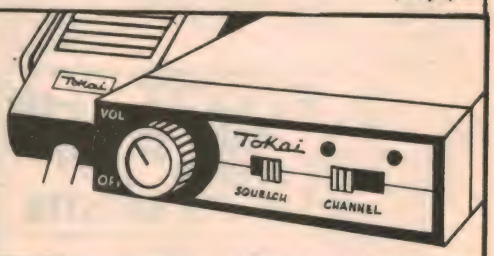
UTAC
5 WATT

Made by **TOKAI** branded by **UTAC**

This is a handsome chunky 5 watt made for the American CB market with the full compliment of 23 American channels. You couldn't buy the bits for this sort of money. So get one while stocks last

- 31 Semiconductors
- All metal case
- Fully synthesised
- P/T/T mike
- Cradle mounting
- 12 Volt DC
- PUB ADD FAC

$99 P&P $3.00



MIGHTY MIDGET

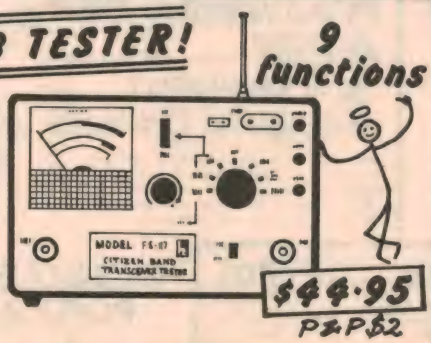
TOKAI 5038B 5 WATT

Back at last the popular 3 channel Tokai 5 watt mobile. This tiny 27 Mc rig really punches out a strong signal. Only 28mm (1⅛") thick. With squelch, sturdy metal case, transmit and standby light, p/t/t remote mike, fused 12 volt lead. If you're after real power this one's for you. Fits into a tiny space.

$99 P&P $3

CB TESTER!

9 functions



$44.95 P&P $2

NINE USEFUL FUNCTIONS

1. Wattmeter
2. S.W.R.
3. Modulation
4. Rel. Field Strength
5. R.F. Oscillator
6. X'tal Checker
7. Audio Oscillator
8. Low Frq. Osc.
9. 5 Watt Dummy Load

Mobile Aerials for 27MC

GUTTER GRIP ABT 20"—mounts in a jiffy. Centre loaded. A terrific performer. Compl.

$19.95 P&P $2

Also spring loaded base.

$22.95 P&P $2

Trunk mount centre loaded. Fibre glass aerial 48" with lead and plug.

$27.50 P&P $2

BASE LOADED SPRING — Heavy duty snap mount S/S whip complete with lead and plug. Xtra range.

$29.50 P&P $2

MARINE SPECIAL—No ground plate needed for glass boats. Centre loaded. Pricey but good.

$49.95 P&P $2

Ground Plane Antennae

27MC 36

High Efficiency Ground Plane Antenna for CB base station. All aluminium construction. Accepts PL 259 connector. Solid aluminium 108 inch heat treated radials and radiator. Elements supplied in two 54 inch lengths joined by threaded coupling nuts. Radial droop for 50 ohm match. Accepts 1¼ inch tubing and PL 259 connector.
Frequency Range 27 MHz Impedance 50 ohms VSWR Less than 1.5:1 Weight 4.5lbs Wave 14.

$49.95 P&P $5.00

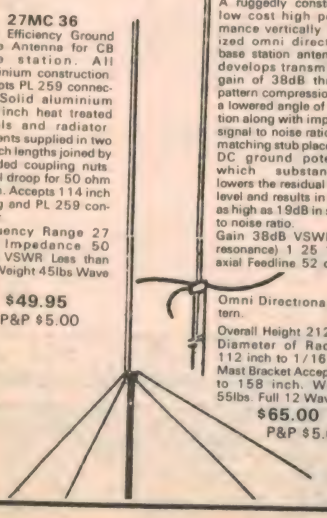
27MC GPV BASE LOADED

A ruggedly constructed low cost high performance vertically polarized omni directional base station antenna. It develops transmitting gain of 3.8dB through pattern compression and a lowered angle of radiation along with improved signal to noise ratio. The matching stub places it at DC ground potential which substantially lowers the residual noise level and results in gains as high as 1.9dB in signal to noise ratio.
Gain 3.8dB VSWR (At resonance) 1.25:1 Coaxial Feedline 52 ohms.

Omni Directional Pattern.

Overall Height 2.12 inch Diameter of Radiator 1.12 inch to 1/16 inch. Mast Bracket Accepts Up to 1.58 inch. Weight 5.5lbs. Full 1/2 Wave.

$65.00 P&P $5.00



PETER SHALLEY CB SPECIALISTS

554 PACIFIC HWY KILLARA NSW 2071
(NEXT TO BLACK STUMP)
TEL~4982611

Tribute to Arthur Thurston:

Metallurgist & Amateur

The death of Arthur Thurston, VK2AV, on May 26 of this year, ended an amateur association of over 50 years. Those who knew Arthur on the air will remember him as a superb CW operator who, during his retirement years, became the anchor man of a well known CW net.

Arthur was always ready to help a fellow amateur and, in spite of the vast technological changes which have taken place since Arthur was granted his licence in 1924, he remained a keen and enthusiastic amateur, always striving to keep abreast of the state of the art, until his death.

He was one of the "old timers" who came up the hard way and, like many of his contemporaries, made his contribution to amateur radio as it is today.

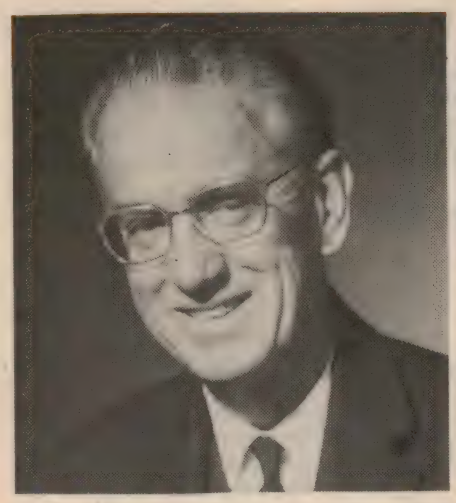
But, of those who knew him on the air, few would have known of his achievements in his chosen career, or the debt which this country owes him for his wartime achievements. The following story is taken, in the main, from the magazine "Metals Australia", September 1972, where it was published as a tribute on the occasion of his retirement.

Born in Rugby, England in May 1907, Arthur migrated to Australia in 1909. The family settled at Cobar, where his father was an engineer at the copper mine. They eventually came to Sydney and Arthur completed his schooling at Sydney Boys' High School, in those days at Ultimo.

His first interest was in wireless and his first job in 1924 was unsealing radio sets which, in those days, were designed to listen to one station only and for which a listening fee had been paid.

His career with O.T. Lempriere & Co. Ltd. started as a junior laboratory assistant in 1925 at Alexandria, studying at the Sydney Technical College. Arthur was awarded the Diploma of Metallurgy, with honours, in 1936. After graduation he became a part-time lecturer in advanced inorganic analysis at the Sydney Technical College, continuing until 1942. Yet, Arthur was more than a lecturer; he was a teacher in the real sense of the word. Many of the metallurgical analysts of to-day owe their skills to the training they received at his hands and their work bears his stamp.

In 1937 he was appointed chief chemist with O.T. Lempriere and following the outbreak of the war there was a complete diversification in the nature of his work.



Arthur Thurston.
(Photo by courtesy of O.T. Lempriere.)

In 1942 Arthur was responsible for the installation of a "medium" quartz spectrograph and applied it to the analysis of refined tin, lead, antimony and their alloys and sundry qualitive analysis of ores and metals. He delivered lectures at Sydney, Newcastle and Wollongong on practical quantitative spectrography and gave practical tuition on the subject at Alexandria.

This was followed by the installation of a Tinsley recording polarograph for the estimation of impurities in copper alloys.

(Of this part of his career a friend remarked: "Among his wartime achievements as a scientist I believe the one that gave him greatest satisfaction was the application of spectrographic methods in metallurgical analysis—a new technique at the time and one in which he was one of the first workers, if not the first, in Australia".)

During this time, OTL were casting Rolls Royce Merlin engine bearings by a patented process. OTL also undertook the chemical testing of US Army Air Force half-inch ammunition links for machine guns. Corrosion of original zinc plating in New Guinea caused trouble with firing stoppages and the loss of a number of aircraft. The plating was stripped and replaced by one of cadmium. The work involved millions of links and careful supervision of the contracting electroplaters.

The Rolls Royce bearings needed a few tenths of a thousandth of indium to be electrodeposited followed by heat treatment to improve corrosion resistance. As no indium was available, Arthur set up a research program, and finally extracted a few pounds of indium from selected tin ores in which it occurred in concentrations of about 0.002 per cent. The process was tedious but it solved the problem. It also enabled OTL to supply indium fluoride to the Sydney Dental Hospital for use in their early work on the effect of fluorides on tooth decay.

During the war period Arthur also attended a bomb disposal school, which was subsequently disbanded when the work was allocated directly to the armed services. He joined the 10th Btn. Volunteer Defence Corps as signals instructor but finished up finally as crew member on a 9.2in coastal defence gun at Cape Banks, the north head of Botany Bay.

In 1946 Arthur was appointed research officer and later technical superintendent at OTL. Later, he was mainly concerned with soft solders and fluxes for engineering and electronics. The formulation of solders, fluxes and tinning compounds for specific purposes and the solution of associated manufacturing problems established Arthur as a leader in this field.

Although conditioned to the rigorous scientific approach of the analyst, Arthur possessed a keen sense of humour. Those who worked with him will always remember his ability to reduce an apparently complex and serious situation to its simplest form and to show that it was not without its funny side.

When Arthur retired from O.T. Lempriere in June, 1972, he had been with the company for 47½ years—in itself a notable achievement.

At Electronics Australia we remember Arthur for his cheerful and helpful manner. In particular we remember the very valuable assistance he provided when, some years ago, we were preparing an article on solders and soldering. Arthur's obvious expertise on this subject enabled us to present a highly accurate and informative article.

In private life Arthur was a happy family man and a keen and active member of his local bowling club. It is a further tribute to his diversity of outlook that he served this club at various times in the capacity of treasurer, secretary, and vice-president.

Arthur is survived by his wife and two sons.

The flipflop family

Apart from logic gates probably the most basic elements in digital circuits are flipflops, which form the basis of sequential logic and storage systems. In this chapter we look at the operation of simple two-gate flipflops, and at the various types of practical flipflop which have been derived from them.

by JAMIESON ROWE

The digital circuit elements we have considered in the foregoing chapters have performed functions which are substantially independent of time. For example the output level of an OR gate will always be true if at least one of its inputs is true, and false only if all inputs are false. This relationship between inputs and output is not dependent upon time, except in a second-order sense: when the input situation changes significantly, it can take a few tens of nanoseconds for the change to propagate through to the output.

In contrast with these circuit elements are others whose function does depend quite significantly on time. The most common of these are the various forms of flipflop, and the monostable or "one-shot". These and one or two other time-dependent circuit elements form the basis of sequential logic circuits, information storage systems, binary arithmetic and counting circuits, and a host of other valuable applications of digital electronics.

For the present, let us turn our attention to flipflops, which are probably the most important of all time-dependent digital elements.

As the name "flipflop" suggests, the most obvious characteristic of these devices is that they are bi-stable. They have two stable operating conditions, and can be made to switch from one to the other.

A very basic flipflop can be formed by connecting two 2-input NAND gates, as shown in Fig. 1. As you can see, the two gates are "cross coupled", with the output of each being connected to one of the two inputs of the other. This forms a regenerative feedback loop, with the result that if the two uncommitted inputs are taken to the true (1) logic level, only one of the gates can have a true output; the other must have a false (0) output.

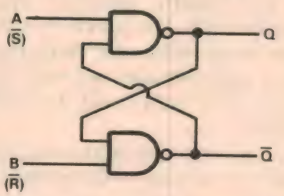
This happens because the output that is true causes both inputs of the other gate to be true, driving the second gate's output false by virtue of the inherent inversion in a NAND element.

Only one output of the flipflop (or "FF") is normally true, then, and the other is false. The two outputs are logically complementary, in other words—each is the logical complement of the other. By convention one output is usually labelled "Q", and the other "Q-bar".

This labelling is quite arbitrary, as the FF is basically a symmetrical device. Normally we are quite free to call either output "Q", as convenient, with the other becoming Q-bar by implication.

The FF has two stable "states", then: one with Q true and Q-bar false, and the other with Q false and Q-bar true. Just which of the two states it will be in at any particular time depends upon its previous history.

For example on each occasion when power is initially applied to the circuit, the FF will always tend to "come on" in the



A	B	BEFORE		AFTER	
		Q	Q̄	Q	Q̄
1	1	0	1	0	1
1	1	1	0	1	0
0	1	0	1	1	0
0	1	1	0	1	0
1	0	0	1	0	1
1	0	1	0	0	1
0	0	0	1	?	?
0	0	1	0	?	?

FIG. 1

same state. This is because there are always small differences in the characteristics of any two gates, so that one gate will always tend to "lead" when power is first applied—steering the FF in the resulting direction. It might always tend to come on with Q true, or alternatively with Q-bar true.

The other main factor which determines the state of the FF is any signals which may be applied, or may have been applied, to the inputs A and B. There are various possibilities here: the FF may have either Q or Q-bar true initially, while either A or B may be taken true or false independently. With three variables, this gives eight different situations, each of which can be analysed using the basic principles of gate operation.

You can try doing this if you like, as it would be a good exercise. However, the results are shown in concise form in the truth table, and it may be sufficient just to consider these carefully. Each pair of lines covers one of the four possible truth-value combinations for the two inputs, with the two lines in each pair covering the two possible initial states of the flipflop.

The first thing to notice is that while ever both the A and B inputs are held true (1), the FF outputs do not alter. This is shown in lines 1 and 2, where you can see that the FF simply remains stable in whichever of the two states it was initially.

The next thing to notice is that if input A alone is taken to the false logic level (0), the FF always ends up in the state where Q is true and Q-bar is false. If it is initially in this state, it simply remains there (line 4), but if it is initially in the opposite state it will promptly change over or "toggle" (line 3).

Conversely, if input B alone is taken to the false logic level, the FF always ends up in the state where Q is false and Q-bar is true. Again if it is initially in this state it merely remains there (line 5), while if it is initially in the opposite state it will toggle (line 6).

By convention it is usual to call the state of the FF where the Q output is true the "set" state, and the alternative state where Q is false the "reset" or "clear" state. So that from the table in Fig. 1 we can see that a false logic level applied to the A input causes the FF to always end up in the set state, while a false logic level applied to the B input causes the FF to always end up in the reset state.

Because of this the A input could be labelled S-bar, as shown in brackets. The "S" stands for "set", indicating that the input may be used to force the FF into the set state, while the bar indicates that a false logic level produces this action rather than a true logic level.

Similarly the B input could be labelled R-bar, as shown in brackets, with the "R" standing for "reset" to indicate that the input may be used to force the FF into the

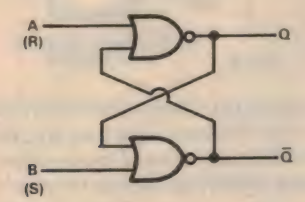
reset state. Again the bar indicates that the input is effective when taken to the false logic level, rather than the true level. An alternative to labelling this input "R-bar" is to label it "C-bar", with the C standing for "clear".

The last pair of possibilities for the FF of Fig. 1 is when both inputs are taken false at the same time. As you can see from the table, this results in an "unpredictable" situation—symbolised by the question marks (lines 7 and 8).

The reason for this is that when both inputs are taken to the false level at the same time, both gates are forced into the condition where their outputs go true. The FF is thus forced into a third state, which corresponds to neither of its two normal stable states. While it will remain in this third state as long as both inputs are held false, it will revert to one of the two stable states as soon as either of the inputs is taken true.

Which of the two states it reverts to depends upon which of the two inputs is returned true first. If B is taken true first, it will revert to the set state, while if A is returned true first it will revert to the reset state.

What if both inputs are returned true simultaneously? Assuming this is possible (and it is easier said than done), then a "race" condition occurs. Both gates will attempt to drive their outputs low, and the



A	B	BEFORE		AFTER	
		Q	$\bar{Q}$	Q	$\bar{Q}$
1	1	0	1	?	?
1	1	1	0	?	?
0	1	0	1	1	0
0	1	1	0	1	0
1	0	0	1	0	1
1	0	1	0	0	1
0	0	0	1	0	1
0	0	1	0	1	0

FIG. 2

outcome will depend upon subtle differences between them in terms of speed, etc.—rather like the situation when power is first applied.

Because of these complications, the simple type of flipflop shown in Fig. 1 is never used in situations where both inputs are likely to be taken to the false logic level and returned true simultaneously. Its use is restricted to situations where a FF is only required to act in response to single false-going input pulses, applied to the S-bar and R-bar inputs in an exclusive manner.

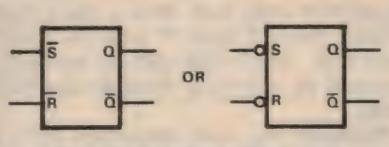
Because the simple type of FF shown in Fig. 1 is only capable of switching back and forth between its set and reset states, it is usually called a "reset-set" or **RS flipflop**.

An RS flipflop can also be made using two NOR gates, as shown in Fig. 2. The method of cross-coupling the gates is virtually identical to that used with NAND gates, and the operation turns out to be rather similar. However, there are subtle differences, as the truth table shows.

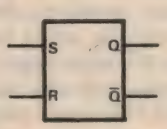
Perhaps the first difference to note is that in this case the "no change" situation occurs when both inputs are held at the false logic level, rather than the true level. This arises from the nature of NOR gates, compared with NAND gates.

For the same reason, the "indeterminate outcome" situation now occurs when both inputs are taken to the true logic level. As before this results in a potential "race" condition, if both inputs are returned to the inactive logic level (here 0) simultaneously.

Superficially it may seem that the two remaining " one input alone" situations are unchanged from the corresponding situations for Fig. 1. However this is not really so. The difference is that here the inputs are effective or "active" when they



(RS FLIPFLOPS WITH ACTIVE LOW R & S INPUTS, EG. FROM FIG. 1)



(RS FLIPFLOPS WITH ACTIVE HIGH R & S INPUTS, EG. FROM FIG. 2)

FIG. 3 R-S FLIPFLOPS

are taken true, rather than when they are taken false as in Fig. 1.

In other words the A input of Fig. 2 acts as a reset or "R" input, the absence of a complementing bar showing that it is active when taken to the true logic level. Similarly the B input now acts as a set or "S" input.

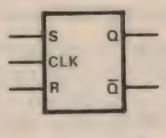
Although simple RS flipflops may be made by cross-coupling gates as shown in Figs. 1 and 2, and this is often done, they are also made available by IC manufacturers as ready-made building blocks. In this form, they are usually represented by the symbols shown in Fig. 3.

The upper symbols show an RS flipflop with active low inputs, like that of Fig. 1 when the positive logic convention is used. Note that there are two possible symbols, one with the inputs labelled S-bar and R-bar, and the other with them labelled S and R but using "bubbles" to indicate that they are active low.

The lower symbol shows an RS flipflop with active high inputs, like that of Fig. 2 when positive logic convention is again adopted.

It is worth noting that an RS flipflop is in fact an elementary "memory" or storage cell. It is able to store one bit (binary digit) of information, whose value is 1 in the set state or 0 in the reset state. The information may be stored in the cell by feeding in pulses at the inputs, with the S input used to store a 1 and the R input to store a 0. If you like, the FF "remembers" which input last provided a pulse.

While a simple RS flipflop has its uses, there are many applications in digital systems where flipflops are required to respond only at certain fixed times, as determined by general timing or "clock" signals which are fed throughout the system. To provide for this sort of operation,



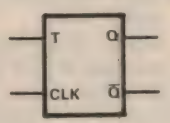
S	R	BEFORE CLK PULSE		AFTER CLK PULSE	
		Q	$\bar{Q}$	Q	$\bar{Q}$
0	0	0	1	0	1
0	0	1	0	1	0
0	1	0	1	0	1
0	1	1	0	0	1
1	0	0	1	1	0
1	0	1	0	1	0
1	1	0	1	?	?
1	1	1	0	?	?

FIG. 4 CLOCKED OR GATED RS FLIPFLOP

a number of variations on the basic RS flipflop have been evolved.

Probably the simplest of these is the **clocked-RS flipflop**, which is shown in Fig. 4. This looks rather similar to the basic RS flipflop, having S and R inputs as before; but there is a difference. Changes in logic level at the S and R inputs now do not cause immediate changes in the state of the FF, they merely condition it to respond in a certain way upon the arrival of a timing pulse at the CLK or clock input.

As you can see from the truth table, the response of the FF when the clock pulse arrives closely parallels that of the basic RS flipflop. If both S and R inputs are at



T	BEFORE CLK PULSE		AFTER CLK PULSE	
	Q	$\bar{Q}$	Q	$\bar{Q}$
0	0	1	0	1
0	1	0	1	0
1	0	1	1	0
1	1	0	0	1

FIG. 5 T-TYPE OR TOGGLE FLIPFLOP

the false logic level when the pulse arrives, the FF state remains unaltered. If the R input alone is held at the true level, the FF will either remain in or switch to the reset state when the clock pulse arrives. Similarly if the S input alone is held at the true level, the arrival of the

clock pulse causes the FF to either remain in or switch to the set state.

If both the S and R inputs are held true when the clock pulse arrives, there is again an "indeterminate" outcome. Following the clock pulse the FF might be left either set or reset, depending upon any internal speed-of-response bias it may possess. In this respect the clocked-RS flipflop is similar to the basic RS type—except that here the indeterminate situation generally only arises if the S and R inputs are held true simultaneously with the arrival of the clock pulse. In most cases they can both be true at other times without producing this result.

Another type of clocked flipflop you may encounter is the so-called **T-type or "toggle" flipflop**, shown in Fig. 5. Like the clocked-RS flipflop this has a CLK input, but in place of the R and S inputs it has a single input labelled "T". This has a controlling effect as shown in the truth table.

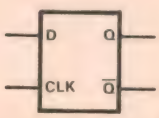
As you can see, when the T input is held false during the clock pulse this has the effect of "freezing" the FF in its initial state; the state after the clock pulse is the same as that before. However, if the T input is held true during the clock pulse, the clock pulse forces the FF to "toggle" or change states—regardless of its initial state. If it was set, it will reset; and vice-versa.

The T-type FF is thus capable of only two responses to a clock pulse. It can either remain unchanged, or toggle, depending upon the logic level applied to the T input. Unlike the clocked-RS FF there is no "indeterminate" response.

A further type of clocked flipflop is the so-called **D-type flipflop or "latch"**, shown in Fig. 6. Instead of the T input this has a "data" or "D" input, whose controlling action is shown in the truth table.

If the D input is held false when the clock pulse is applied to the FF, its effect is to cause the FF to either remain in, or switch to the reset state. Conversely if the D input is held true, the arrival of the clock pulse causes the FF to either remain in the set state, or switch to it.

In other words, the D-type FF acts rather like a clocked-RS FF which has an S input and an R-bar input, tied together internally. When the D input is high it causes the FF to be set, like an S input,



D	BEFORE CLK PULSE		AFTER CLK PULSE	
	Q	Q̄	Q	Q̄
0	0	1	0	1
0	1	0	0	1
1	0	1	1	0
1	1	0	1	0

FIG. 6 D-TYPE FLIPFLOP OR LATCH

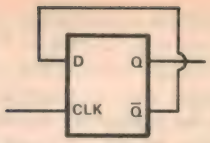


FIG. 7 D-TYPE FLIPFLOP CONNECTED FOR TOGGLING

and when it is low it causes the FF to be reset, like an R-bar input.

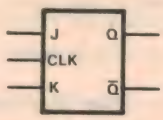
The reason for calling the D-type FF a "latch" is that when the clock pulse arrives, it effectively stores whatever the logic level happens to be at the D input—"latching" it in storage until the arrival of the next clock pulse.

Note that like the T-type FF, the D-type FF always operates in a determined fashion; there is no "indeterminate" situation, where the outcome cannot be predicted.

Incidentally, the D-type FF can be used as a toggling FF simply by connecting its D input back to its Q-bar output, as shown in Fig. 7. This forces the FF to toggle to its oposite state each time a clock pulse arrives, like a T-type FF with its T input held true. You might care to verify this yourself by checking through the truth table.

Probably the most important type of clocked FF is the so-called **JK flipflop**, which is shown in Fig. 8. This is a very flexible element, in that it can be arranged to perform virtually all of the functions performed by the other types.

The JK flipflop has two main inputs in addition to the CLK input, and as you can



J	K	Q (BEFORE)	Q (AFTER)
0	0	0	0
0	0	1	1
1	0	0	1
1	0	1	1
0	1	0	0
0	1	1	0
1	1	0	1
1	1	1	0

FIG. 8 JK FLIPFLOP

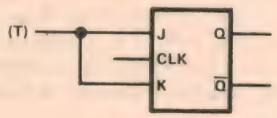
see these are labelled "J" and "K". As shown in the truth table, these function rather like the S and R inputs of a clocked-RS flipflop. But there is one important difference—when both J and K inputs are held true during the clock pulse, the outcome is no longer indeterminate. The FF simply toggles, like a T-type FF with its T input held true.

In a sense, then, the JK flipflop is virtually an "improved" version of the clocked-RS flipflop, designed so that its operation is always completely predictable. If the J and K inputs are held false, it will remain unchanged; if the J input alone is held true, it will set; if the K input alone is held true, it will reset; and if both J and K are held true, it will toggle.

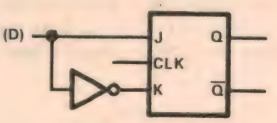
JK flipflops are used in large numbers in most digital circuits and systems, because of their flexibility. As an example of this , Fig. 9 shows how JK flipflops may be used to perform the same functions as a T-type FF (upper diagram) and as a D-type FF (lower diagram). In one case the J and K inputs are simply tied together, while in the other case the K input is fed through an inverter whose input is tied to the J input, so that it always receives the complement of the logic level applied to the J input. Or if you like, the inverter effectively changes the K input into a K-bar input.

You might care to verify for yourself that these connections cause the JK flipflop to act like the T-type and D-type flipflops, using the truth table of Fig. 8 for reference. This would help to reinforce the concepts in your mind.

Practical JK flipflops quite often have other inputs in addition to the basic J, K



JK FLIPFLOP USED AS A T FLIPFLOP



JK FLIPFLOP USED AS A D FLIPFLOP

FIG. 9

and CLK inputs. Some of these are illustrated in Fig. 10—but note that not all of the inputs shown would necessarily be provided on any particular device.

In addition to the J and K gating inputs, there may also be provided J-bar and K-bar inputs which are active for the opposite logic polarity. These may either be labelled J-bar and K-bar, or have the usual J and K labels but with "bubbles" to indicate the active-low function for the positive logic convention. The diagram shows the latter approach.

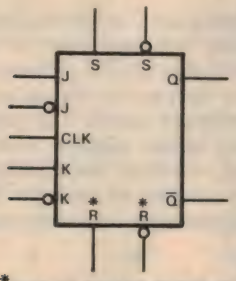
The flipflop may also be provided with direct-acting S and R inputs, quite separate from the inputs concerned with clocked operation. These may again be either active-high or active-low, with the latter labelled either S-bar and R-bar (or C-bar) or S and R (or C) with bubbles. Direct-acting S and R inputs enable a JK flipflop to be preset to the set or reset state, as required, before its clocked operation takes place.

There is one further type of flipflop which you may encounter sometimes in digital circuits. This is again a simple RS flipflop, but one made up from two inverters as shown in Fig. 11.

Having two inverting logic elements cross-coupled, this circuit has two stable states like the RS flipflops shown in Figs. 1 and 2. But note that because it uses inverters, its outputs are in fact identical with its inputs.

To make this very basic FF change its state, one of the input-output terminals must be "forced" briefly to the opposite logic level, against the cross-connected output. Generally this causes no harm, because almost immediately after the input reaches the "other" logic level, the FF changes state to maintain the new state of affairs.

Unlike the RS flipflops in Figs. 1 and



*MAY BE CALLED CLEAR (C)

FIG. 10 POSSIBLE CONNECTIONS ON A PRACTICAL JK FLIPFLOP

2, however, the inputs of Fig. 11 do not become "inactive" when they have triggered the FF to switch to its opposite state. Both input-outputs are active here at both logic levels, so that the FF is quite capable of following rapid alternations of logic level. This means that care must be taken if a simple two-inverter FF is used for such applications as "debouncing" signals derived from mechanical switch contacts. We will look at this further in a later chapter.

Although we have looked at a number of different flipflops in this chapter, this

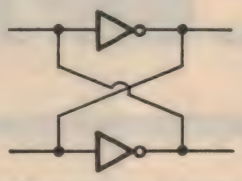


FIG. 11 RS FLIPFLOP FROM TWO INVERTERS

has been largely for the sake of completeness. It isn't really necessary to memorise the detailed operation of every one, as the main ones you are likely to encounter are the simple RS type (Figs. 1, 2 and 11) and the JK type (Figs. 8, 9 and 10).

An important thing to bear in mind about flipflops in general is that they are usually quite symmetrical devices, so that most of the labels applied to their inputs and outputs are arbitrary. This means that if it is convenient to do so, there is generally no reason why you can't swap the labels around. For example you could swap the Q and Q-bar outputs of a JK flipflop as in Fig. 8, providing you also swap the labels for the J and K inputs to match. If there are also S and R inputs, these would have to be swapped as well.

The only thing to watch when this is done is that you don't forget any inputs and outputs which are not one of a pair. Some of these will change into their logical complement, while others won't change at all. For example a CLK input doesn't change, nor does a T input; but a D input will change into a D-bar input. Similarly if the FF only has a nominal R input, it will become an S input; and if it only has a nominal Q output, this will become a Q-bar output.

Finally, a word on packaging. Flipflops tend to come both singly and in multiples. If you want an elaborate JK type, with the full complement of inputs, you'll probably find they come only one to an IC package. But if you need only simple JK types, you may well find that suitable types come as packages of two, or even four. And if you have an application requiring a number of basic T-type or D-type FFs, you may be able to get these in packages of six or eight together.

Classical Recordings

Reviewed by Julian Russell

Julius Katchen re-issue: recommended

BRAHMS—Piano Concerto No.1 in B Minor. Julius Katchen (piano) with the London Symphony Orchestra conducted by Pierre Monteux. Decca Stereo SBA385. Ballade in B Minor (Katchen).

One of the outstanding features of this reissue is a realisation of the powerful contribution made by the orchestra under Pierre Monteux. One seldom thinks of French conductors in terms of communion, with Brahms. For that matter I can conceive of no stranger an event than enthusiastic reception by a Parisian audience of a Bruckner symphony performed by a French orchestra. But in this recording The London Symphony Orchestra under the late, great Monteux shows no trace of Frenchification of the orchestral part but a full-blooded Brahms, deeply lyrical in parts and elsewhere stormy in its dramatic impact. The performance is now 15 years old and the sound is sometimes not quite so sharp edged as in many more recent versions but the total result is so good that this can be easily forgiven.

Here you have the late Julius Katchen at his finest, technically terrific and capable of great power without harshness, as well as passages of the most moving poetry. Katchen, who died a few years ago at the wasteful age of 42, was a friend of mine and my admiration of him was boundless. It still is, enough to make any allowances necessary for the enjoyment of his performance. And however massive Katchen's well prepared climaxes, Monteux is always there with him as he is in the sweeter, more feminine passages. In 1969 I had arranged to meet Katchen at the Strasbourg Festival and arrived there only to learn that he had died a few weeks earlier in Paris where he had been domiciled for many years. His death was caused by vicious generalised cancer. It is sad to speculate on what heights he would surely have reached had he been spared, for at his age he was in a class of his own. This record provides a noble tribute to his memory and I can recommend it, especially at its budget price, with the greatest enthusiasm.

And as a bonus you have an equally impressive performance by Katchen of the Ballade in B Minor.

Sviatoslav Richter: good in parts

SCHUMANN—Piano Concerto in A Minor

GRIEG—Piano Concerto in A Minor. Sviatoslav Richter (piano) with the Monte Carlo National Opera Orchestra conducted by Lavro von Matacic. EMI Stereo/Quadraphonic OASD 3133.

I know of no better player of Schumann's piano music than Sviatoslav Richter, so that I looked forward eagerly to hearing his account of the A minor concerto. And as much as I admire him, I must confess to some slight disappointment with the first movement, disappointed with both the pianist and the orchestra. The "expression" seemed to me often grossly overdone with too many rubatos and lingerings, quite unlike the perfect, romantic approach Richter usually awards this composer. In this work you have to wait till the second movement to hear Schumann playing of the standard one has come to associate with this player. Here is Schumann played with all the poetry Richter can give it and the orchestra adjusts adroitly to his changed mood. The balance between soloist and orchestra is always satisfactory, by the way. In this second brief movement even the cello never exaggerates a bar of his lovely part. The finale is taken briskly but so fluently that the listener is never worried by a sense of undue hurry. Beautiful moments are too numerous to mention individually but I cannot refrain from special mention the little fugato for orchestra and piano that is completely bewitching.

I was again disappointed in the Grieg. I cannot imagine any informed listeners approving the ultra slow tempo of the opening bars of the first movement. It is quite freakishly so, and I cannot understand why. It certainly doesn't add to the work's stature which is often criticised—and played—as if it were miniaturised. And as if to underline his opinion. Richter similarly drags the second subject of the same movement.

Some years ago Katchen and Mackerras played the concerto in the Sydney Town Hall and their combined reading lifted the work into larger than usual dimensions with the, to me, happiest of results. But they did this without any freakish mucking about with the score. Their reading simply contradicted Debussy's unkind description of Grieg's music as "snow wrapped in pink papper."

Another point: when Richter reaches a genuinely slow sequence he over-romanticises it shamefully. I'll leave the performance to you to find other features to be indignant about. The Monte Carlo Orchestra under Matacic follows Richter's lead, whether they privately agree with his reading or not. To me it is a tiresome example of Homer nodding.

* * *

DUKAS—Symphony in C Major. L'Apprenti Sorcier. London Philharmonic Orchestra conducted by Walter Weller. Decca Stereo SXLA6770.

As an admirer of many other works by Dukas I must confess to slight disappointment with this C Major Symphony. It offers little that is new in form and its eclectic style shows paucity of originality when compared to such other works of his as L'Apprenti Sorcier and La Peri. There are many moments in the first movement very reminiscent indeed of Schubert—with a French accent. Parts of the working-out section are all too predictable. Although it opens with a melody which recalls one by the early Richard Strauss, and later even shows Wagnerian influences, it, not surprisingly, includes those of Debussy. But here and there you will hear more typical Dukas scoring with high divisi strings so magically used in L'Apprenti Sorcier. Not missing either are sequences that owe much to Cesar Franck, the Franck of the D Minor Symphony. You will find most of these in the Finale. But in this movement there is one exquisite, sinuous melody much more characteristic of the Dukas I have admired for the best part of a long lifetime.

There is nothing wrong with the playing of the London Philharmonic Orchestra under Walter Weller who finishes the work with a long, invigorating coda.

L'Apprenti Sorcier is presented here in its abbreviated form and is beautifully played and recorded. But I am afraid the symphony will appeal more to students of French music than the general public.

* * *

TCHAIKOVSKY—Symphony No. 6 in B Minor. (Pathetique). Philharmonia Orchestra conducted by Carlo Maria Giulini. HMV Concert Classics Stereo SOXLP 30208.

This is a very welcome reissue. The original was recorded back in the very first days of stereo in 1961. In the first place, the engineering is excellent even

in terms of the most modern techniques. In the first movement the first subject, though taken very fleetingly, is beautifully articulated. And Giulini's handling of the famous second subject (Starry Night-ugh) is unique so far as I can recall. Giulini lets the music speak for itself, with some rubatos, of course, but never any hint of wallowing. Without sacrificing any of its beauty he somehow succeeds in making it sound more reflective than overwrought, It is a refreshing change from the way it is so often played by many of his present-day colleagues who add different kinds of frenzy, according to how they see it. However, Giulini never makes the theme sound tame but just an impressive foil to the following working-out section with its disciplined turmoil leading up to a tortured climax.

It is a masterly conception.

The next movement – the 5/4 – marked by the composer allegro con grazia couldn't be played more gracefully. He manages to make it sound like a beautifully modulated conversation.

Giulini takes the third movement very fast but quite without any suggestion of scrambling. He starts it very delicately and leads it almost imperceptibly into a splendid climax. And again there is no frenzy. He conveys in the Finale a mood of dignified, regretful leave-taking rather than the more usual emphasis on self-pity. I thought it quite wonderful although I can well understand others might be quick to disagree with me.

The performance is now some 15 years old but you would never guess its age from the sound. Very highly recommended.

★ ★ ★

MOZART–Concerto for Two Pianos and Orchestra in E Flat Major. (K.365) Ashkenazy and Barenboim (pianos) with the English Chamber Orchestra conducted by Barenboim. Concerto for Three Pianos and Orchestra in F Major (K.242). Ashkenazy, Barenboim and Fou T'Song (pianos) conducted by Barenboim. Decca Stereo SXLA 6716.

These two works make for very easy listening, very clean and crisp without any of the tiresome reverberation that might have accompanied the simultaneous recording of three pianos and orchestra. There is also throughout the two concertos a pleasing sense of relaxation which, however, doesn't prevent the intrusion of passages of rare enchantment. The first movement of the double concerto is as fluent "as all get out" and, if some of the changes of tempo are a little unexpected, it all adds to the unbuttoned fun. Unhappily the next movement is not so attractive. It drags so laggardly that it comes close to sounding lugubrious, which certainly wasn't Mozart's intention. Indeed at this tempo it's quite a feat for the English Chamber Orchestra to keep their many trills so immaculately unanimous. But the exaggerated slowness gives the impression that the movement has been stretched on a rack. This quite cancels the gaiety of the first movement and I don't think it could have been the player's intention.

But none could quarrel with the very real gaiety of the Finale which at times seems as if the players were having a whale of a time. Neither this concerto nor the Triple Concerto is top-drawer Mozart, but the Triple is the weightier, more serious of the two. In this Ashkenazy and Barenboim, who conduct both works from the piano, are joined by Fou T'Song. All three play in such perfect rapport that without a score one would be hard put to it to tell when one, two or all three instruments are playing at the same time. Yet despite this very impressive feat all three sometimes pay scant attention to the composer's specfic instructions. The English Chamber Orchestra plays with its usual peerless expertise.

★ ★ ★

BEETHOVEN–Symphony No. 6 F Major (The Pastoral). Chicago Symphony Orchestra conducted by Sir George Solti. Decca Stereo SXLA6763.

Much of your attraction to this record will depend on your personal liking for Solti's personality. He is possibly, despite his undeniable talents, one of the most extraverted conductors before the public today. Among his recordings one has only to remember his Ring series and his Tristan to understand what I mean. These caused great excitement when they first came out but enthusiasm for them has waned a little since competing issues arrived. However I have always found Solti an exciting conductor and, although this seems at odds with even the nickname for this work (The Pastoral) I nevertheless enjoyed the performance immensely. Much of this is due to the quality of the recording which in every way matches Solti's large-scale thinking. It is weighty but wide enough in its dynamic range to permit of the expression of the subtlest delicacies. It is as crisp as any I've heard and its clarity is exemplary.

Although he uses more or less orthodox tempos Solti makes full use of Beethoven joyfulness and his deep love of nature. I have a feeling that Solti himself enjoys much the same things. If he doesn't, he assumes the mantle of one who does with the utmost conviction. His reading is at the other end of the scale to the old, great Bruno Walter's exquisitely gentle recording of the work back in the days of 78s. Indeed those who accept Walter's as ultimate perfection will not listen as kindly to Solti's. The latter is so different that I advise prospective buyers to listen to this new recording before "taking the plunge." Personally I enjoyed it all immensely but you may well think otherwise. I am sorry that I cannot be more explicit than this, but musical tastes differ as widely as performances, and this one is for me.

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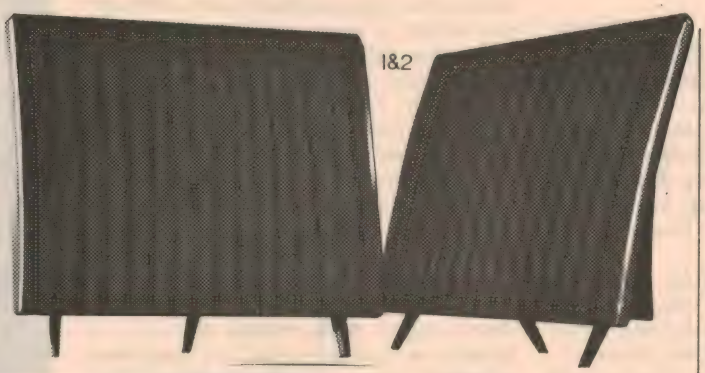

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BM1

Lighter Side

Reviews of other recordings

Devotional Records

LILLY. Lilly Green. Stereo, Destiny D-9909S. (From S, John Bacon Pty Ltd, 12-13 Windsor Ave, Mt Waverly, Vic 3149. $6.95.)

The sound on the opening tracks is pure "disco", with vocal solo backed with piano, organ, synthesiser, guitars, drums, horns and various other instruments. But then the sound becomes more relaxed and the message more personal. The album, as such, is a natural for after-church "coffee shops".

As mod Gospel, it's very well performed and very listenable but Lilly Green, who wrote and performs all the songs, says that she will have failed in her objective if people merely react to the tunes or use them as background to communal chatter. They are songs with a definite message which comes through if you pause to listen:

Food For The Hungry – Starin' At The Wall – Hot Or Cold – Light My Way – Satan I Rebuke You – The Good Life – God, A Woman, And A Man – Come As A Child. For those contemplating marriage, the track "God, A Woman, And A Man" is a new, and different and meaningful wedding pledge.

Recorded in Hollywood, and imported from Destiny Records, the quality is excellent and, all round, I must rate it as a highly successful and thoroughly listenable Gospel recording despite (for some) the "disco" opening. Playing time is about 30 minutes.

★ ★ ★

A SIMPLE SONG OF LOVE. Sonshine Circle. Stereo, Light LS-5670-LP. (From Sacred Recordings Aust, 181 Clarence St, Sydney and other capitals.)

While backed with drums and rhythm guitars, along with other instruments, the album "A Simple Song Of Love" has a strictly middle-of-the-road sound: modern without being off-putting to the older generation. Undoubtedly this is quite deliberate but it also fits in with the title theme and the jacket notes. Incidentally, the song from which the album takes it's title would really go over big in a rally or evening gospel service, with "Sunshine Song" or "How I Love Jesus" as an encore.

The full list of track titles: All Day Song – Don't Let The World Get In Your Soul – Didn't He – More Like You – A Simple Song Of Love – Peter's Song – Sunshine Song – Oh How I Love Jesus – Words – Beginnings.

It's the kind of album that tends to grow on one and, apart from family listening, would be of interest to groups on the lookout for new material. From the jacket notes I gather that a vocal score would be available from the distributors. (W.N.W.)

★ ★ ★

GESUALDO. Madrigals and Sacred Music. Robert Craft conducting the Gesualdo Madrigal Singers. Stereo cassette, Harmony (CBS) HMC 539.

Completely unaccompanied, the Gesualdo Singers display their training and their abilities in the way they cope with a quite lengthy program of difficult material, every word of it in Latin: Volgi, Mia luce – T'amo mia vita – Or che in gioia – O sempre crudo amore – Deh coprite il ben seno – Cor mio deh non piangete – Dunque non m'offendete – Aestimatus sum – O dolorosa gioia – Non t'amo, voce ingrata – Che fai meco – Questa crudele – Dolcissima mia vita – Psalmi delle Compiete.

Those with a specific interest in the contents of this cassette should find considerable pleasure in the performance by the Gesualdo Madrigal Singers, but its appeal will be small outside this strictly limited circle. Technically, the gentle harmony, devoid of dynamic excursions, poses no problem for the recordist and quality is smooth and even.

As I said, limited appeal, but noted for the sake of those who are interested in this kind of music. (W.N.W.)

Instrumental, Vocal and Humour

A MOZART PROM. Lawrence Foster conducting the Royal Philharmonic Orchestra. Decca Phase Four stereo, PFS.4314.

If you're at all partial to Mozart, this should be found a most enjoyable recording. It features three well-known and often played pieces: the overture from The Marriage of Figaro, the Horn Concerto No. 4 in E flat, and the Symphony No. 40 in G. minor.

They're played in fine fashion, too. The

Reviews in this section are by Neville Williams (W.N.W.), Jamieson Rowe (J.R.) Leo Simpson (L.D.S.), Norman Marks (N.J.M.) and David Edwards (D.W.E.).

LIGHTER SIDE—continued

Figaro overture bubbles over with joyous anticipation, as it should, while in the horn concerto soloist Alan Civil does full justice to Mozart's graceful and romantic writing. The playing of Symphony No. 4 on side 2 is also of a very high standard combining precision with warmth and sensitivity.

Made in 1973, the recording is also of a high standard.

In short then, a very enjoyable disc and one which would be an excellent Mozart sampler. (J.R.)

★ ★ ★

LEHAR. Highlights from Giudetta. The Gunther Arndt Choir and Berlin Symphony Orchestra conducted by Werner Schmidt-Boelcke. World Record Club stereo WRC S/4527.

There is really only one disadvantage in buying this album. The performances are so stirring, especially that of the soprano, Sylvia Geszty in the role of Giudetta, that you may wish to go out and obtain the complete performance. If you wish to cultivate an appetite for light opera, then this album is an ideal appetiser. It is sung in German but that does not in any way reduce the pleasure. Record quality is very good. (L.D.S.)

★ ★ ★

J. S. BACH: BRANDENBURG CONCERTOS No. 4-6 Stuttgart Chamber Orchestra conducted by Karl Munchinger. Decca stereo SPA.383.

This is a re-issue of a recording made in October 1958 at the Victoria Hall in Geneva. The first three concertos are also available, on SPA.382. Both have been re-released in Decca's "World of the Great Classics" series.

Written in 1721 when Bach was 36 and Kapellmeister at Cothen, the six Brandenburg concerti are written in the concerto grosso form rather than for solo instrument and orchestra. They are vigorous and inventive, and make most enjoyable listening—whether or not you find Bach's organ music to your taste.

If you're after a warm and brisk performance of the last three concerti, this recording is well worth a listening. The recording itself sounds rather dry, and lacking in reverberation depth, but is otherwise quite good considering its age. (J.R.)

★ ★ ★

THE WORLD OF THE SEA. Decca World Of The Great Classics SPA396.

Decca have chosen a number of well known works that are most evocative of the sea and its many moods. Some of the tracks, Britten's 'Peter Grimes' for instance date back to 1959, others being a little more recent. Side one opens with the overture to Wagner's "Flying Dutchman", followed by the "Sinbads Ship" from Scheherazade and "La Mer" by Debussy.

On side two Kenneth McKellar sings "Sea Fever" with two excerpts from "Peter Grimes", three sea shanties from Malcolm Arnold and Percy Grainger's "Scotch Strathspey and Reel". As might be imagined, the quality varies a little from track to track, but not enough to detract from the enjoyment.

If you're starting on a classical collection, records such as this form a good sampler to explore different composers' style. (N.J.M.)

★ ★ ★

GILBERT AND SULLIVAN OVERTURES. Gilbert and Sullivan Festival Orchestra. Conducted by Peter Murray. Astor Records SPLP 1454.

Gilbert and Sullivan is not exactly everyone's cup of tea, and I cannot claim to be a particular fan. However, if like me you find the music quite enjoyable without the vocal, then these excellently recorded overtures are well worth a listen.

Track titles are: The Mikado – HMS Pinafore – The Yeoman Of The Guard – Iolanthe – Ruddigore – The Gondoliers – The Pirates Of Penzance. (G.S.)

TABOO. The Exotic Sounds of the Arthur Lyman Quartet. Astor Hifi record stereo ASF 509. Three-record set at $5.99.

If you like the sounds of an exotic orchestra with a background of pseudo tropical birdcalls then this three-record set will be a feast at the bargain price of $5.99. Surface noise was obtrusive on some tracks of my sample and tape hiss is noticeable at times also. Still, at the price it is undoubtedly good buying.

Some of the many tracks are as follows: Red Sails In The Sunset – Yellow Bird – Quiet Village – One Night In Nagoya – My Shawl – Jungle Drums – Black Orchid – Taboo. (L.D.S.)

★ ★ ★

SPAIN'S GREATEST HITS. CBS Odyssey ODA 5067.

To call music as enduring and enjoyable as this "Hits" is something of a misnomer, as the record represents some of the best known music to come from that country.

There are eleven tracks in all, featuring such artists as Sergio and Eduardo Abreu, Shirley Verrett, John Williams, Philippe Entremont as well as the orchestras of Andre Kostelanetz and Leopold Stokowski. The composer, Falla, is well represented, with Spanish Dance from "La Vida Breve", Ritual Fire Dance, Gypsy Song from "El Amour Brujo" and the Dance from "The Three Cornered Hat".

Others are Granados, Casals, Albeniz and Rodrigo. The sleeve notes give you a good run-down on the composers and the eras in which the music was written. Coupled with excellent quality and delightful music, the record is a bargain at any price. (N.J.M.)

★ ★ ★

LENNY DEE featuring I'LL PLAY FOR YOU. Astor, stereo MAPS 8175.

It might be thought that this album is devoted to mistily romantic music, if one were to judge from the cover and title. But this is not so. Lenny Dee continues his usual Hammond style to supply easy listening music for driving or relaxing. Record quality is good.

Ten tracks are featured: Love Will Keep Us Together – At Seventeen – Solitaire – How Sweet It Is – Love's Theme – Brazil – I Only Have Eyes For You – When Will I Be Loved – Wasted Days And Wasted Nights – I'll Play For You. (L.D.S.)

POPULAR CASSETTES

MOTORING MUSIC 4. The Gil Vermont and Albert Lizzio Orchestra with the Branjo Hronzes Sound, the Cornely Singers, Henry Arland. Contata Stereo Dolby cassette A-108. (From Goldring Sales & Service.)

The "Motoring Music" series appeal as being the most successful of the current batch of Contata tapes. As in this case, they involve a variety of musical groups who produce a constantly changing program sound; on the pop side of M.O.R., as distinct from a dozen numbers played by the same group. The tracks here:

Bye, Bye My Love – A Lollipop For Sis – Oje Comova – If You Could Read My Mind – Spanish Eyes – Mamy Blue – Loretta – Pied Piper – The World We Know – Brazil – What Will Be Tomorrow – Three O'Clock In The Morning – Tender – Limbo Las Vegas.

The sound is clean and the stereo spread excellent. Remember that it's Dolbyised so either push the Dolby switch or turn down the treble slightly. (W.N.W.)

★ ★ ★

LOVE SONGS. The Sonaro Orchestra, with Jerry Winter, Anette, Mel Torme and Jimmy Shigeta. Dolby stereo cassette, Contata A-114. (From Goldring Sales & Service.)

There are love songs and love songs – the old traditional evergreens, and others of more recent brew. For the most part, the selections on this cassette fall into the latter category: I Don't Stand A Ghost Of A Chance – Speak To Me My Love – Please Don't Go – A-Oh-Much – Love Child – I've Just Seen Her – Unchained Melody – Song From The Moulin Rouge – Sleep In – Where Do You Go To – I'll Remember – Conversations – The Way It Used To Be.

I can't say that the program did much for me, either for its content or the somewhat stringy quality of the sound. However, others may react quite differently. (W.N.W.)

★ ★ ★

PIANO SONG BOOK, MOVIE THEMES. Liberace and Orchestra. Stereo, MCA (Astor) Musicassette BCT 5256.

Say what you like about Liberace, there are few musicians that can top him when it comes to presenting the lush, romantic sound that is so easy on the ear—and that goes so well with soft lights and the all-too-rare relaxed dinner. And, of course, the themes lend themselves to the occasion:

Fascination – Around The World In 80 Days – Summertime – Gigi – Bewitched – All The Way – Moonlight and theme from "Picnic" – The Earth Is Mine – Love Is A Many Splendoured Thing – Secret Love – And This Is My Beloved – Three Coins In A Fountain.

As I said, it's all very pleasant, the quality is good and, if you want to add an M.O.R. cassette to your collection, this would have to be it. Playing time would be about 40 minutes. (W.N.W.)

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HOBBY NEWS

SEPTEMBER, 1976

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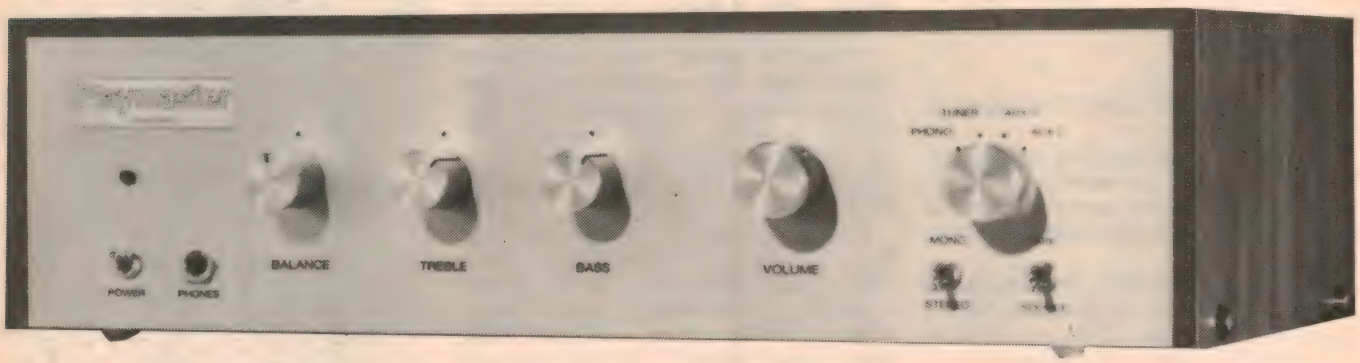

A new upgraded version of the popular PLAYMASTER TWIN 25 has now been released. Working closely with Leo Simpson we have redesigned the transformer and fitted a special heatsink to the power transistor. The prototype was thoroughly tested at Electronics Australia and is reviewed in the September Issue of the magazine. The basic kit sells for $99.50 which makes it the lowest cost 40W amplifier on the market.

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LIGHTER-Continued

LOVE. Ronnie Aldrich and his Two Pianos with the London Festival Orchestra. Decca Phase 4 PFS 4361.

I sometimes wonder how Ronnie Aldrich copes with two pianos, he probably plays one of them by ear! Apart from this, on this album there are twelve very easy listening tracks on the most popular theme of all–Love:

Quiet Nights – The Nearness Of You – I Didn't Know What Time It Was – Once Upon A Summertime – All The Things You Are – The Days Of Wine And Roses – I Will Wait For You – Tenderly – The Sounds Of Love – Watch What Happens – The Party's Over.

The record sets a mood of relaxation that is most enjoyable and the excellent sound quality of Decca's Phase 4 process gives no cause for complaint. (N.J.M.)

★ ★ ★

AL HIRT-JUMBO'S GUMBO. Monument L 35771. Festival release.

Al Hirt has been described as the world's greatest trumpet player. Such a claim is always open to dispute, but don't let that stop you from enjoying eleven tracks of old and not-so-old favourites in the jazz idiom, such as: Monkey Farm – Limbo Rock – Theme From The Prisoner Of Second Avenue – Butterfly Days – Mexican Horse Race – If I Could Be With You – Peanuts – Before The Next Teardrop Falls – Bingo – The Sound Of Jazz And The Scent Of Jasmine – My Buddy.

The quality is excellent, making in all a very easy to listen to album. The recording was made at the Monument studios and Ray Stevens Sound Labs in Nashville. (N.J.M.)

★ ★ ★

MEXICAN GOLD. Pepe Jaramillo. E.M.I. Studio 2 stereo TWOX 1047.

Pepe Jaramillo's Latin-American piano and rhythm produce yet another fine album here. He is a most consistent performer and it is a pleasure to recommend another of his albums. Record quality is good.

Track titles are: El Bimbo – Once Is Not Enough – Hasta La Vista – Stranger In The Shadows – Harmour Love – Laughter In The Rain – Mexican Gold – Sing Baby Sing – Don't Stay Away Too Long – The Importance Of Your Love – The Greatest Gift – The Gondolas Of Venice. (L.D.S.)

★ ★ ★

FILL THE WORLD WITH LOVE. Ferrante and Teicher. United Artists L 35782. Festival Release.

Here is another collection of beautiful popular songs and movie themes from Ferrante and Teicher. Their superb musicianship and piano wizardry combines to produce an admirable album of background music, just the thing for playing at dinner parties and the like.

The sixteen tracks would use up too much space to list, so I'll only mention the ones that caught my ears. These are: Where Do I Begin – I Don't Know How To Love Him – For All We Know – MacArthur Park.

Record quality was excellent. You can be sure of getting many hours of enjoyment from this record if you take the plunge. (D.W.E.)

THIJS VAN LEER/INTROSPECTION 2. Arranged and conducted by Rogier Van Otterloo. CBS stereo SBP 234785.

For several years Thijs Van Leer was a key member of the world-renowned Dutch band "Focus". He has now branched out and established a fine reputation as a flautist and composer. His second album is a fitting sequel to the first, which was also entitled "Introspection". Most of the pieces featured might be termed jazz interpretations with a baroque flavour. And while the mood is mostly what the title suggests, one track, "Rondo II" has a decidedly up-tempo style which could make it a favourite track for showing off any hifi system.

Leer's polished flute is backed by an orchestra of equal standard in arrange-

PETER AND THE WOLF—ROCK STYLE

PETER AND THE WOLF. Various artists. RSO 2394 162. Phonogram Release.

Yes, this is yet another version of Prokofiev's well-known composition but this time a "rock" one. Manfred Mann plays Peter, Gary Brooker plays Bird, Chris Spedding plays Duck, Stephane Grappelli plays Cat, and Eno plays Wolf. The narration is by Viv Stanshall, and various other musicians help to fill in the gaps.

Producers Lancaster and Lumley have not followed the original score very closely. In fact, only seven of the twenty-one tracks use Prokofiev's music. The remaining tracks are new compositions by the producers, which seem to fit in well enough with the original works. A further difference is that extensive use has been made of modern electronic instruments.

My overall impression of the record was good; it is very listenable and certainly strikingly different. Recording quality is excellent, with very little background noise. The stereo effects are good, without at any time intruding. Included with the album is an illustrated booklet with the narration included in English, French, German, Italian and Spanish. I understand that other versions of the record are obtainable with the narration in these languages. (D.W.E.)

LIGHTER SIDE—continued

ments that always complement rather than overpower. Record quality is good throughout. Highly recommended.

Track titles are: Goyescas No IV – Rondo II – Introduction – Siciliano – Focus III – Larghetto – Sheep May Safely Graze – Mild Wild Rose – Bist Du Bei Mir – Carmen Elysium. (L.D.S.)

★ ★ ★

PIANO MASTERPIECES 1900-1975 Floyd Cramer. RCA APLI 0893.

Ten of the best piano favourites are the content of this enjoyable disc from one of America's favourite pianists: Dizzy Fingers – The Entertainer – Canadian Sunset – A Walk In The Black Forest – Sunrise Serenade – Maple Leaf Rag – Near You – Piano Roll Blues – Java – Last Date.

The Nashville sound is up to the usual expectations as far as quality is concerned and the hand of Chet Atkins as producer should ensure a good performance from all concerned. Scott Joplin's 'The Entertainer' was recorded before a live high school audience, the rest of the tracks being a studio job. (N.J.M.)

★ ★ ★

COUNTRY AND WESTERN HITS VOL. 1. Unknown artists. 3 record set. Stereo. Astor SF302.

For $5.75, this three record set seems fairly good value. All told, there are 30 tracks, each of which has been a C&W hit (in America, it seems). No details are given as to who performs on each track. One is left to assume that they are meant to be close copies of the original versions. Still, for less than $2.00 a record, one shouldn't be too critical.

The 30 tracks are too numerous to list here, so I'll only mention a few: Harper Valley P.T.A. – Bill Bailey Please Come Home – Only Daddy That'll Walk The Line – What's Made Milwaukee Famous – Tear For A Friend – Another Time Another Place.

Record quality is excellent, with some very pleasant arrangements. I would not recommend that you play all the records consecutively, however, as you may not want to listen to any more C&W music for a long time! (D.W.E.)

★ ★ ★

THIS TIME I'VE HURT HER MORE THAN SHE LOVES ME. Conway Twitty. MCA Records MAPS 8274. Astor release.

Here is another collection of beautiful songs from Conway Twitty, which will grace any C&W collection. His pleasant voice wends its way through ten songs, covering the themes we have come to expect from him. The majority of the tracks are concerned with love in some form or other, without at any time becoming monotonous.

Tracks featured are: This Time I've Hurt Her More Than She Loves Me – She Thinks I Still Care – Jason's Farm – She Sure Does Make It Hard To Go – You Love The Best Out Of Me – She Did-It Did-I Didn't – The Race Is On – She Takes Care Of Me – Woman Lovin' Kind Of Man – On My Way To Losing You.

To my mind, the best tracks are the title track and "Jason's Farm". Technically, I was a little disappointed with my pressing, as I could detect slight traces of distortion in sections. Otherwise it was quite good. (D.W.E.)

★ ★ ★

DESTROYER. Kiss. Casablanca NBLP 7025. Astor release.

My first impression of this album was gained from the cover, which shows the four members of Kiss leaping out at you, wearing what I can only describe as "nightmare fantasy" clothes. Really, you'll have to see it to appreciate it. Needless to say, the album contents were as I expected, very loud (and very good) rock. The album was produced by Bob Ezrin, so I was not surprised to detect similarities in style with Alice Cooper's "Welcome To My Nightmare",

which he also produced.

The album gets off to a good start with the first two tracks, but never quite seems to reach the same heights again. Nearly all of the tracks are very loud and fast, except one on side two, entitled "Beth". This is a much slower number, which I found quite pleasant. Other tracks I enjoyed were: Detroit Rock City – King Of The Night Time World – Shout It Out Loud – Do You Love Me.

So there you are, if you like very loud rock and roll, have a listen. (D.W.E.)

★ ★ ★

THE MOM AND DADS, MEMORIES GNP Crescendo L 35814 Festival release.

I imagine this is how the wool shed bands used to sound before the rock bands came on the scene. The old family album photos on the jacket help set the period for most of the tracks, with such titles as: Memories – Old Spinning Wheel – Maiden's Prayer – Music, Music, Music – Are You Lonesome Tonight – Bill Bailey – Alice Blue Gown – Isle Of Capri – Does Your Heart Beat For Me – Ma – Tears On My Pillow – Silver Bell. Nostalgic, pleasant. (N.J.M.)

★ ★ ★

THE VERY BEST OF WELSH CHOIRS. EMI EMC 3099 Stereo.

A choral feast would be the best description of this record with sixteen tracks from three world famous male choirs: the Morriston Orpheous Choir, the Monmouthshire Massed Male Choir and the Treorchy Male Choir.

Some of the titles are: Men Of Harlech – God Bless The Prince Of Wales – Hiraeth – Laudamus – All Through The Night – Land Of My Fathers – Llef – Myfanwy – Calon Lan – Guide Me, Oh Thou Great Jehovah.

There is a little surface noise on some tracks but not enough to quibble about. I imagine that this record would make many a Welsh heart homesick. I wouldn't blame them. (N.J.M.)

★ ★ ★

DIANA ROSS. Diana Ross. Stereo. Tamla Motown STMLO/10135. EMI release.

This offering from Diana Ross is superb. The album gets off to a tremendous start with the theme from the movie "Mahogany", and maintains the same high standard throughout. With styles that range from vaudeville to soul, Diana shows off her talents very well.

Tracks featured are: Theme from Mahogany (Do You Know Where You're Going To) – I Thought It Took A Little Time (But Today I Fell In Love) – Love Hangover – Kiss Me Now – You're Good My Child – One Love In My Lifetime – After You – Smile – Ain't Nothin' But A Maybe.

Quality wise, my review copy was excellent. I can only say that this record should delight you, musically and technically. (D.W.E.)

New Products

New microphone with "shotgun" converter

The Primo Company of Japan has recently added two new microphones to their well-known range. One of these is a high-quality dual-purpose electret capacitor type which should be of particular interest to recording and sound movie enthusiasts, while the other is a dynamic type designed especially for communications work.

The model EMU-4545 is a new high-quality cardioid microphone, using an electret capacitor insert. It comes in a metal case with black satin finish, and with an integral windshield. Power for the internal FET preamp/matching stage comes from a single 1.5V penlight cell, which fits inside the case.

An on-off switch is fitted to the microphone, and the switch also provides for two response characteristics. One is a "music" (M) position, giving a flat response, and the other is a "voice" (V) position in which the bass is rolled off at a slope of 6dB per octave to improve balance for close-up vocal work.

Response of the microphone is rated as 50-15,000Hz ±3dB, with a rated sensitivity of –73dB and a signal to noise ratio of 45dB. The front to back ratio at mid frequencies is typically around 23dB, falling to around 12dB at low frequencies and 7dB at 7kHz. Side response is typically 6dB down from the front response. Output impedance is a nominal 600 ohms, and the microphone is supplied with 6 metres of twin-shielded cable terminated in a 6.4mm jack plug.

The EMU-4545 is sold together with the EM-70, which is a "shotgun" converter or adapter unit. The EM-70 is actually a complete shotgun microphone "front end" which mates with the "rear end" of the EMU-4545 in place of the cardioid front end. Like the latter it is an electret capacitor unit, but it uses a tube with long side slots and controlled interior damping to phase out side response over the 400-7000Hz part of the spectrum. This gives improved directionality, particularly for voice work.

Together the EMU-4545 and the EM-70 thus form a high quality dual-purpose capacitor microphone kit, capable of functioning as either a cardioid or shotgun unit at will.

Frequency response of the EM-70 unit is typically 50–15,000Hz ±4dB, with a sensitivity of -75dB at 1kHz and a signal to noise ratio of 50dB. Maximum input level is 118dB, referred to 1V/uBar. Front to back ratio at mid frequencies is typically around 23dB, with side response typically 20dB down. Both are rated at better than 12dB down over the range 400–7000Hz, where the phasing system is operative.

As it uses the same "rear end" as the EMU-4545, the EM-70 has the same out-

Above is the basic EMU-4545 cardioid microphone, while at right is the unit with the EM-70 "shotgun" converter.

put impedance and output cable. It also provides the same two response curve options.

Although we have no anechoic chamber to test microphones in a fully instrumented manner, we were able to try the EMU-4545 and EM-70 microphones in a number of recording situations using high quality equipment. They gave a very creditable performance indeed, with every evidence of smooth response, low distortion and low noise. Subjectively the EM-70 gives a very useful increase in directionality over the basic cardioid pattern, for recording in noisy situations.

In short, they would seem to be high quality microphones, and as a dual-function pair they should be very suitable for general recording and movie sound work.

The other new Primo is the model DM-1515. This is a dynamic model, designed especially for mobile radio, amateur radio, CB and other communications work. It comes in a black moulded case of high-impact Cycolac, and is fitted with a breath baffle and press-to-talk switch (SPST). The case is moulded for convenient hand-held use, and is also provided with a hang-up spigot on the rear. A mating bracket is supplied, for attachment to the equipment or other suitable place.

Frequency response of the DM-1515 is deliberately tailored for communications work, being typically 3dB down at around 300Hz and 5kHz. The microphone has a sensitivity of −71dB, is unidirectional and has a nominal impedance of 500 ohms. It comes with a spiralled cable, which has a retracted length of about 300mm. No connector is provided at the end of the cable, the manufacturer apparently having decided that there are too many different connectors likely to be wanted.

We tried out the sample DM-1515 with a small transmitter, and its signal quality seemed very smooth and clean. Our impression is that it would be a good choice for most mobile and other communications work.

Primo microphones are imported by Paradio Electronics, and should be available at most trade outlets. Suggested retail prices quoted for the microphones reviewed here are as follows: EMU-4545/EM-70, $64.00; DM1515, $8.50. Both include tax. (J.R.)

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NEW PRODUCTS

Trio CS-1562 10MHz Dual Trace CRO

The Trio CS-1562 is a lower-priced version of the CS-1560 reviewed in December 1975. Vertical amplifier bandwidth is DC to 10MHz, and maximum sensitivity is 10mV/cm. Circuitry is all solid-state, with a total power consumption of 20W. A regulated power supply renders the unit insensitive to mains voltage fluctuations.

Overall dimensions of the CS-1562 are 280 x 240 x 433mm (W x H x D) including knobs, feet and rear projections. Mass is 8kg. A tilting bail is fitted to enable adjustment of the viewing position.

Vertical deflection sensitivity is variable in eleven ranges from 10mV/cm to 20V/cm, with continuous variation on each range available from a small knob concentric with the range switch.

Nineteen ranges in a 1-2-5 sequence from 0.5sec/cm to 1us/cm are provided for the timebase, with continuous adjustment again available from a small knob concentric with the range switch. In addition, the horizontal trace position control can be pulled out to provide a 5X magnification of the sweep signal.

An attractive feature of the timebase switch is that the variable knob can be rotated fully clockwise to give X-Y operation, with the CH2 signal becoming the horizontal component. This makes Lissajous figure operation or similar comparison of two signals and easy matter. And the fact that the full gain of CH2 (10mV/cm) is available makes it even more attractive.

Two switches and a small control knob give fairly comprehensive sync and trigger selection facilities. The TV line and TV frame sync pulse triggering facility is incorporated into the timebase switch and is automatically selected depending on the timebase range. Similarly, the selection of chopped or alternate trace operation is also incorporated into the timebase range switch.

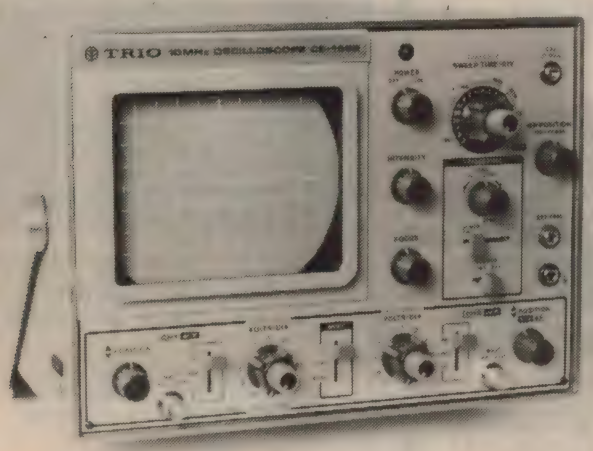
Three display modes are available: CH1, CH2 or Dual. Vertical inputs can be AC or DC coupled, or grounded. Input impedance is 1M shunted by 22pF. Claimed AC bandwidth is 2Hz to 10MHz (-3dB points). We found this spec easily met, even at the full 6cm deflection.

The CS-1562 is easy to drive, and the well written manual outlines a number of useful measurement methods. The traces are particularly bright and sharp and waveforms with fast risetimes are easily viewed. Like its stablemate the CS-1560 it is a most attractive instrument and one which we can thoroughly recommend.

Accessories supplied include the instruction manual, a couple of pin plugs and two PC-17A probes. These probes may be switched from 10:1 attenuation to direct connection by disconnecting the tip portion of the probe and reinserting after rotating through 180 degrees. Input impedance in the attenuation mode is 10M shunted by 18pF.

Price of the CS-1560 is $379 plus sales tax where applicable. This includes the two PC-17A probes and other accessories noted above, so it is good value for money.

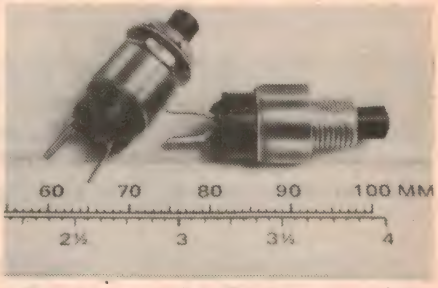
Further information can be obtained from the Australian distributors for Trio instruments, Parameters Pty Ltd, 68 Alexander Street, Crows Nest, NSW 2065 or from major electronic parts suppliers. (L.D.S.)



The CS-1562 is very similar in features and circuitry to the model CS-1560. Main difference in performance appears to be the reduced bandwidth of 10MHz.

NEW PRODUCTS

Miniature momentary pushbutton switch



A unique switch in C & K's comprehensive switch range is the 8531 SPST subminiature momentary pushbutton switch. By specifying the "C" terminal option, it is suitable for PC board mounting.

Electrical life is 1 million make-and-break cycles; contact rating is ¼A resistive at 120VAC and 28VDC, or ½A resistive at 250VAC. The 8531 is normally open with overtravel. Actuation force is 230g.

Dimensions are 9.52mm diameter, with an overall length of 27mm from plunger top to terminal tip. Options include a choice of three different contact materials, epoxy seal and white, black, red, yellow or green plunger caps.

Further information from C & K Electronics (Aust), PO Box 101, Merrylands, 2160. Telephone 682 3144.

New electronics company

Bryan Catt, a well known identity in the Australian electronics industry, has formed a new components company called Bryan Catt Industries (BCI).

Located at 105 Miranda Rd, South Miranda 2228, the new company is ideally situated for electronics enthusiasts and manufacturers in Sydney's southern suburbs. The company carries an extensive range of electronic components and portable electroplating equipment, as well as the full range of components imported by Instant Component Service.

. . . and another

Formed last May by a partnership headed up by Erle Goodwin, Brian Reimann and Leo Levin, Electronics Development Sales Pty Ltd has been appointed exclusive Australian distributors for a number of overseas companies. These include:

- Cambridge Thermionic Corp., Massachusetts (electronic hardware, RF components);
- E & L Instruments Inc., Connecticut (breadboarding equipment and accessories); and
- Western Microwave Labs Inc., California (ferrite devices, isolators, mixers etc).

In addition, the company will promote and distribute the products of its associate company Electronic Developments & Service Pty Ltd. The new company's address is 27 Buckley St, Marrickville, NSW 2204.

Low frequency generator has low distortion

A new low-frequency generator, the PM5107 from Philips, combines very low distortion, ease of use, sine/square wave and TTL outputs all in a compact, lightweight unit. Although designed for audio development and servicing use, the generator is also suitable for education purposes, having straightforward controls, robust construction and moderate cost.

Star feature of this versatile instrument is the very low distortion figure of typically 0.02%, which is claimed to be the lowest for generators of this size and price range. The PM5107 will fully meet the demand for greater signal purity now spreading from laboratories to service centres as domestic hi-fi sales increase.

Output frequency from 10Hz to 100kHz is set by a large, fully variable control and range multiplier push-buttons to an accuracy better than 4%. Signal amplitudes to a maximum of 2V for sine waves and 4V for square waves are set by variable control. A fixed 20dB attenuator can be push-button inserted to simulate output signals from recorders, etc.

For further information contact Philips Scientific and Industrial Division offices in each state.

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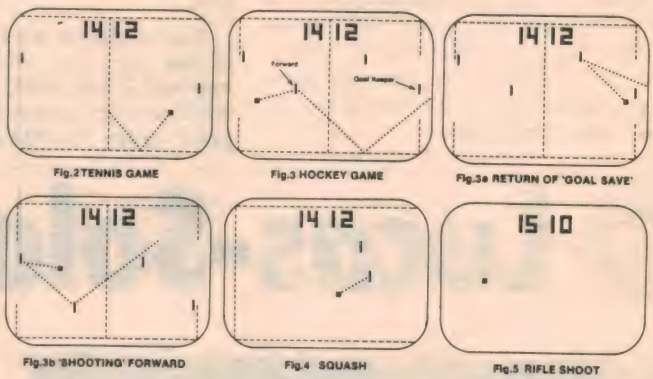

Fig.2 TENNIS GAME
Fig.3 HOCKEY GAME
Fig.3a RETURN OF 'GOAL SAVE'
Fig.3b 'SHOOTING' FORWARD
Fig.4 SQUASH
Fig.5 RIFLE SHOOT

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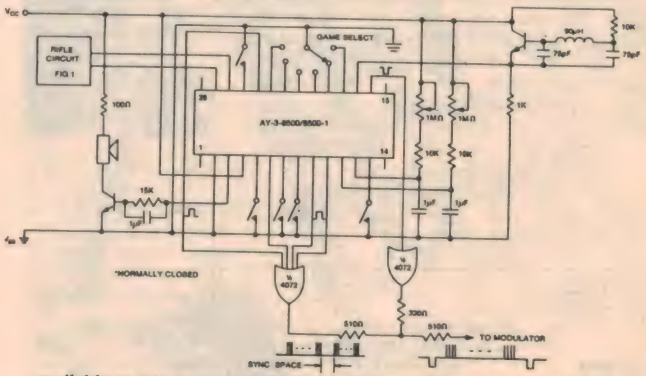

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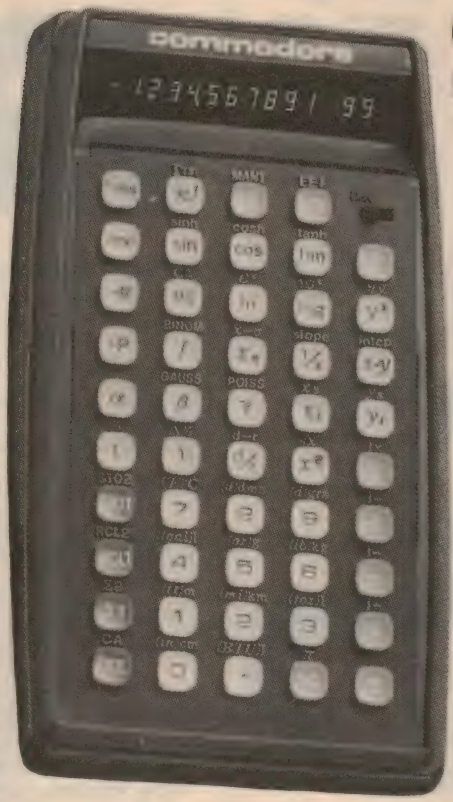

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Commodore is perhaps the oldest brand in consumer electronic calculators. The SR4190R was designed, developed and produced in Palo Alto, California. Other Commodore plants are located in Osaka, Japan, Toronto, Canada and Eaglescliff, England.

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A Brief Summary of the SR4190R

10-digit Mantissa, 2-digit exponent with Variable Exponent Integer Increase and Decrease: MANT, EE, EE ↑, EE ↓

Register Keys: STO 1, RCL 1, Σ1, STO 2, RCL 2, Σ2, x↔y, Xn, Xi, Yi, α, β, γ, ( ).

One Real Variable Function Keys: ln, log, e^x, 10^x, 1/x, $\sqrt{x}$, x^2, SIN, COS, TAN, INV SIN, INV COS, INV TAN sinh, cosh, tanh, INV sinh, INV cosh, INV tanh

Two Real Variable Arithmetic Function Keys: + − × ÷

Two Complex Variable Arithmetic Function Keys: j +, j −, j ×, j ÷

Two Real Variable Analytical Function Keys: →P, →R, P^n_m, y^x, $\sqrt[x]{y}$, %, Δ%, C^n_m

Statistical Function Keys: x↔y, SLOPE, INTCP, GAUSS, BINOM, POISS, x_s, y_s

Hours-Minutes-Seconds Mode: HMS

Unit Conversions: (°F) C, (d) dms, (d) gra, (gal) l, (oz) g, (lb) kg, (ft) m, (mi) km, (f oz) l, (in) cm, (BTU) J

Degree/Radian Conversion and Mode Keys: d/r, d↔r

Numerical Entry Keys: 0-9, π

3 Angular Units: radians, degrees, grads

Poisson and Binomial probability densities. Gaussian distribution.

Mean and Standard Deviation PLUS Linear Regression Analysis.

Power supply: Built-in rechargeable Ni-Cad batteries. AC adapter/recharger included.

6 month warranty

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Please send.....Commodore SR-4190 106 Function Scientific Calculator(s) at the limited price offering of only $79.95 plus Sales Tax if applicable plus $2.50 shipping and insurance each. If not completely satisfied I can return it for an immediate refund (shipping and insurance charges excluded).

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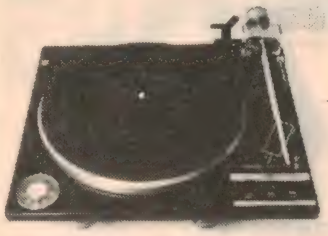
SPECIAL PURCHASE—NEW GARRARD RECORD CHANGERS AT A FRACTION OF LIST PRICE

Garrard M82 Transcription Record Changer



$57.00

Recommended retail price $120.00

SPECIFICATIONS

Type: fully automatic transcription turntable ● Motor: four-pole synchronous ● Mains switch: double-pole switch with suppressor ● Drive: intermediate wheel ● Record play: plays up to six records automatically and single records automatically or manually as required ● Turntable: 10½in. diameter cast aluminium ● Pickup arm: aluminium section, resiliently mounted adjustable counterbalance weight, slide-in C3A cartridge carrier, precision-loaded ball-bearing pivots ● Stylus force: adjustable up to 4gm by sliding weight, minimum recommended ¾gm. ● Bias compensation:. lever and weight calibrated for conical and elliptical styli ● Cue and pause: damped action. Record speeds 33⅓, 45 and 78 rev/min ● Tab controls: auto/stop /start, man off/on, cue/play/lift

Supplied with Pickering Magnetic Cartridge with Diamond stylus.

Post & Packing: (Reg. post) N.S.W. $3.60, Vic, S.A., Qld. $4.74, Tas. $5.50, W.A. & N.T. $6.75.

Garrard 6-400 Record Changer

$28.50

Recommended retail price $48.00

SPECIFICATIONS

Fully automatic turntable plays up to six records automatically and single records automatically or manually as required. 10" turntable. Bias compensation. Cue & pause control with damped action. Record speeds 33⅓, 45 and 78 rev/min. Finished in black with silver trim. Player and changer spindles supplied.

Supplied with high quality Garrard/Sonatone Ceramic Cartridge with Diamond stylus.

Bases in walnut or teak with perspex covers available.

New C800 STEREO AMPLIFIER

$149

(freight extra)

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- Elegant and functional design
- Push-button controls
- Microphone input with separate control
- Provision for simulated 4-channel stereo
- Cabinet in teak or walnut oiled finish with matching metal trim.

SPECIFICATIONS

- Power output: 25 watts per channel R.M.S. Total output 50 watts R.M.S. 8 ohms.
- Frequency response: 20 cycles to 40,000 ±1dB.
- Hum and noise: Aux. 70 dB. Mag 60 dB.
- Input sensitivity: Mag. 2mv. Aux. 250mv.
- Equalised: Mag. RIAA.
- Tone controls: Bass 50cs ±13dB. Treble 10Kcs 15dB.
- Harmonic distortion: Less than 0.1 percent.
- Loudness control: 50cs 10dB.
- Scratch filter: (high filter) at 10kcs 5 dB.
- Rumble filter: (low filter) at 50cs 5 dB.
- Provision for tape recorder: Record or playback with din plug connector.
- Speaker switching: two sets of speakers can be connected and selected by switch on front panel.
- Headphones: headphone jack is situated on front panel.
- Dimensions: 16½in x 11in. deep x 5in high.
- Weight 16 lbs.
- Power supply: Regulated power supply with switching protection for output transistors.
- Semiconductors: 33 Silicon transistors plus 7 diodes.

New MAGNAVOX—MV50—50 WATT SPEAKER SYSTEMS

As featured in Feb. 1976 issue of Electronics Today

Complete kit of parts (less cabinet) comprising Magnavox 10-40 10" bass unit. 625 mid range 6" two XJ3 dome tweeters, crossover network, innabond, speaker silk & plans of cabinet.

$69.00

Per Kit freight extra per rail or air freight. Cabinet available

COMMAND B/S SPEAKER SYSTEMS

Bookshelf speakers in attractive teak finished cabinets measuring 15" by 10" by 7" deep.

These units are fitted with 6" magnavox dual coned speaker (6JX) with a frequency response TO14000 cycles & a rating of 10 watts.

Special price per pair

$34.00

Post & packing (reg. post) W.A & N.T. $6.75 N.S.W. $3.60 Vic. S.A. Qld $4.75. Tas. $5.70

MAGNAVOX 8—30 SPEAKER SYSTEM (4 Way)

DRIVE UNITS: Magnavox 8-30 high performance 8" bass unit. Magnavox 6J 6" mid range speaker. Magnavox new high fidelity dome tweeters (two supplied). SPEAKER KIT: (less cabinet) comprises above speaker, 1mh inductance, 1 8mfd and 1 4mfd. polyester capacitor, 1-3" and 1-6" tube, innabond, speaker silk and plans of cabinet.

$52.00 per kit

Post & pack (reg. post) $6.50 W.A. $10.50 Cabinets available

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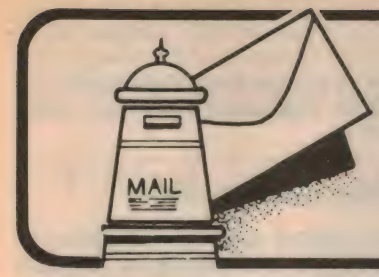

Letters to the editor

NWC signal change

I read with some interest your article in the July issue describing the derived frequency reference from North West Cape. While I can but admire the work that has obviously been put into this project, I would strongly advise you to discourage your readers from investing money in what will soon become unusable equipment.

A reconfiguration of the VLF transmission mode is in hand, and shortly it will be changed to a type unusable by the equipment described.

D. T. Burnheim
VLF Site Officer,
US Naval Communication Station
Exmouth, WA

COMMENT: Thank you for your advice, which we have published as soon as we could. This development was quite unforeseen, not just by ourselves but also by other organisations using the signals as a frequency reference. All those affected will have to explore other possibilities, and we will let readers know if we find any solutions. In the meantime we must certainly advise readers to "hold fire".

Project troubleshooting

Your construction articles are fine, but what happens if they don't work?

Could we have something on how to fix them? Also I would like something on how to fix simple faults on black and white TVs. Incidentally, I like the "Serviceman".

J. Smith
West Leederville, WA.

COMMENT: We do try to include troubleshooting advice in as many constructional articles as possible, but we will certainly look into separate articles along the lines you suggest.

RFI from colour TVs

With regard to the letter you published in the May issue of Electronics Australia, from a reader who had experienced radio interference from a Philips colour TV receiver, and your comment regarding this, I have been asked by our Consumer Products division in Clayton, Victoria, to convey the following comments:

"We think that the comment is a little premature in nominating the switching mode power supply as the basic cause of interference, and that this should be proven by specific tests. We also perceive that a potential source of interference radiation could come from fundamental or harmonics from the line deflection circuitry. This is almost certainly the case and, this being so, should apply equally to each and every brand of Colour TV on the market, not particularly the Philips brand."

G. P. Sprague,
Philips Industries Holdings Ltd,
Melbourne, Vic.

COMMENT: We are happy to publish the comment, and agree that harmonics from the line output section may well be an alternative, or additional, source of RFI. This would make the problem even less specific to Philips sets, or even to colour sets in general. Presumably this is a matter worthy of further investigation by the ABCB.

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia".

Books & Literature

Background reading

ELECTRONICS POCKET BOOK, 3rd Edition by P. J. Goldrick, C. Eng, MIEE, MSMPTE. Published by Newnes/Butterworths, 1976. Hard covers, 349 pages, 19 x 13mm, illustrated by circuits and diagrams. Price in Australia $9.00.

Earlier editions of this book were edited by J. P. Hawker and J. A. Reddihough and, while I did not have them on hand for comparison, it is evident that the contents of this third edition are in line with current theory and practice.

It begins at the beginning—with electrons—but not in the usual way. The reader is carried rapidly into the realm of magnetic and electric fields and is soon involved in solid-state and thermionic devices, with the latter in the minor role.

Chapter 4 looks at "Transistor Circuit Techniques", which is introductory to longer and more deliberate chapters on amplifiers AC and DC, and oscillators. The reliance on circuits, graphs and basic algebra emphasises that the book has been written for those who are familiar with the jargon but who need something to help them sort it out.

Logic and logic circuits receive fairly brief coverage next, followed by an equally brief coverage of ICs.

The final third of the book has electro-industrial overtones, with chapters on photo-electric devices, electronic measurements, electronic control, electro-magnetic devices, power supplies, installation and safety, reference data, and an index.

Overall, it contains a lot of useful information but deserves its title of "Pocket Book"—more an orderly compilation of wide-ranging mid-level theory than systematic coverage of selected subjects. But, like many such pocket books, it could be valuable to the person who wants to broaden their general background by spare-time browsing. Our review copy came from Butterworths, of 586 Pacific Highway, Chatswood 2067. (W.N.W.)

Active device data

RADIO VALVE AND SEMICONDUCTOR DATA, 10th Edition, by A.M.Ball. Published 1975 by Butterworth & Co, London. Stiff paper covers, 179 pages 275mm x 210mm. Price in Australia $4.50.

The fact that this book was first published in 1949, and is now in its 10th edition, is an indication of its acceptance and usefulness as an industry reference. A statement on the title page indicates that it contains details of 1000 valves and cathode-ray tubes, and 9800 transistors, diodes, rectifiers and optical semiconductors. While there would be no hope of publishing full specifications of so many devices, inspection of the book suggests that the data is a good deal more comprehensive and carefully set out than in many other publications we have seen.

There is a contents list at the front of the book, followed by an explanation of the symbols used and the nature of the listings which follow. Valve data comes first, sub-divided in terms of class of valve and manufacturers. Semiconductor devices are treated in a similar way. Towards the back of the book, about 15 pages are devoted to base diagrams and connections, followed by an index and a guide to similar types for both valves and semiconductors.

Companies acknowleged as having provided the basic information are primarily those operating in the UK, so that the book relates primarily to the British scene. Even so, it should be of considerable assistance to those who need all the help they can get in identifying valves, diodes, transistors and other such devices.

The review copy came from Butterworths, 586 Pacific Highway, Chatswood, NSW 2067. (W.N.W.)

Logic theory

INTRODUCTION TO LOGIC AND SWITCHING THEORY, by N.N. Biswas. Gordon and Breach Science Publishers Ltd, London, 1975. Hard covers, 158 × 235mm, 354pp, many diagrams. Price in UK 12.80.

The author of this book is a professor of electrical engineering and computer science at the Indian Institute of Science in Bangalore, India. In this book he has produced a most erudite and scholarly introduction to digital logic and switching theory, intended as a text for senior first year graduate students, and also to help practising design engineers.

I imagine that it may well find itself used for the former, but frankly I doubt whether it will be used for the latter—not

because of any failure of the author to communicate his chosen subject, but because so much of the subject he has chosen is rapidly sliding into obsolescence.

Minimalisation theory and techniques, for example. It made sense ploughing through these when logic gates cost more than design labour, but now the position is reversed and quite often it is far more economical to leave a logic circuit as you first draw it. This is assuming you design your system in hard-wired logic at all, of course—and not as a program for a microprocessor.

My guess is that in a few years' time, logic design as we now know it and as described in Professor Biswas' book will be almost entirely an historical curiosity, at least for all but a handful of people in microprocessor design labs.

Even these people may not need to bother, because they will probably be using CAD (computer-aided design) techniques, and relying on the system to keep track of logic rules. Still, to the extent that they may have to bother with the details, books like this one may be needed. (J.R.)

Using a 'scope

SERVICING WITH THE OSCILLOSCOPE, By Gordon J. King. Second Edition, published 1976 by Newnes-Butterworths, London. Hardcovers, 208 pages 220mm x 140mm, freely illustrated. Price in Australia $10.00.

First published in 1969, "Servicing With The Oscilloscope" has been substantially up-dated in this new edition, reflecting the greater sophistication of modern oscilloscopes and their role not only in servicing, but in general laboratory evaluation of electronics equipment. According to the preface, greater weight has been given this last aspect.

The first 21 pages provide an "Introduction To The Oscilloscope" but it is not intended as a primer. The author assumes that the reader knows what electronics is all about and is concerned only with making sure that the reader understands voltage and frequency calibration, sweep modes, rise time, the significance of rectangular waveforms, etc.

The next 100-plus pages, the largest section of the book, is concerned with the use of the oscilloscope with television receivers, both monochrome and colour. The author takes each section of the TV receiver in turn, showing what the waveforms and response curves should look like—with the help of numerous, well taken CRO-screen photos.

The final 50-odd pages deal with the testing and evaluation of FM/stereo tuners and other items of hifi gear.

Gordon King is a prolific and accomplished author and I have no doubt that many readers will find assistance in latest example of his work. Our copy came from Butterworth, 586 Pacific Highway, Chatswood, NSW 2067. (W.N.W.)

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A versatile high quality mike. For professional recording in studios and perfect for use with tape recorders. Freq. Response: 50-13 kHz. Power Supply: AA type, UM-3 (1.5v). Output Level: (1000Hz)—68 dB ± 3 dB. Comes complete with swivel mount stand adaptor, wind screen and a 15' cable. ONLY **$12.50 each.** P&P $1.25.

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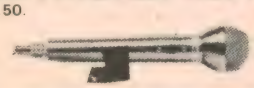

Impedance: 50K ohms. Sensitivity: -58dB/1,000cps. Frequency Response: 100-10,000cps.

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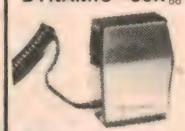

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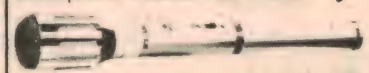

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AD 9710/MC	8½" Twin Cone	$28.00	$2.50
AD 8066/W8	8" Woofer	$17.00	$2.50
AD 7066/W8	7" Woofer	$16.50	$2.50
AD 5060/W8	5" Woofer	$11.00	$2.00
AD 5060/SQ8	5" Mid Range	$21.50	$2.00
AD 0210/SQ8	5" Dome Mid Range	$32.50	$2.50
ADF 3000/8	2 Way Cross Over	$9.50	$1.00
ADF 500/4500/8	3 Way Cross Over	$14.00	$1.00
ADF 600/4000/8	3 Way Cross Over	$24.00	$1.50

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AD 12K12	12"	3 Way	$229/pr.

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B200	8" Woofer	$33.00	$3.25
B139	13" x 9" Woofer	$65.00	$5.00
DN13	2 Way Cross Over	$11.50	$1.00
DN12	3 Way Cross Over	$20.00	$1.50

MAGNAVOX SPEAKERS

Type	Description	Price	P & P
10.40	10" Woofer	$20.50	$3.00
8.30	8" Woofer	$14.00	$2.50
10WR	10" Twin Cone	$11.50	$2.50
8WR	8" Twin Cone	$9.50	$2.50
6WR	6" Twin Cone	$8.80	$2.00
6.25	6" Mid Range	$13.50	$2.00
6J 15Ω	6" Mid Range	$5.80	$1.50
XJ3 15Ω	Dome Tweeter	$7.20	$1.25
MV 50	3 Way Cross Over	$17.00	$1.25

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1 DN12 CROSS-OVER UNIT
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1 MID-RANGE ENCLOSURE
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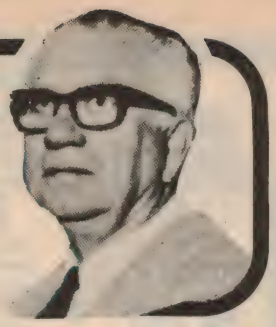
by Pierce Healy, VK2APQ



Amateur radio—public relations image

Good public relations have been defined as the means to an end. Such a principle must be applied to amateur radio in order to maintain and improve its status in the foreseeable future.

A means to that end is to publicise to all community levels, all activities, both technically and socially orientated, that are associated with amateur radio.

This month, the subjects covered are well worthwhile emphasising to those who need to be enlightened about amateur radio and its worth to the community.

AMATEUR SATELLITE NEWS

The complexity of planning, construction and testing necessary for the AMSAT phase III spacecraft can be judged from the following timetable, designed to tie in with a probable launch in mid-1978. This will be the eighth orbiting Satellite Carrying Amateur Radio (OSCAR) in the series.

In line with the spacecraft design which commenced at the beginning of 1975 and the preliminary design review in May 1976, engineering development work will continue until the beginning of 1977.

The engineering concept will be tested during the first half of 1977, culminating in a critical design review. Fabrication of the spacecraft flight unit is scheduled to be completed by the end of 1977. Testing of the completed flight unit will be carried out during the first quarter of 1978.

Concurrently with development work on the spacecraft during 1976, the development of a prototype ground control station has been undertaken. Evaluation of the prototype ground station will be made during the first half of 1977.

Fabrication of ground station equipment is to be completed by the end of 1977 for testing with the flight unit, and despatched to the several control station sites in readiness for the launching of the spacecraft.

The AMSAT–OSCAR VIII spacecraft is an international project (see "The Amateur Bands–Electronics Australia" July 1975, page 99), clearly showing the versatility and cooperation within the ranks of the amateur service.

The spacecraft facilities will be freely accessible to amateurs in all countries; a real example of multinational friendship, fostered through the media of amateur radio communication.

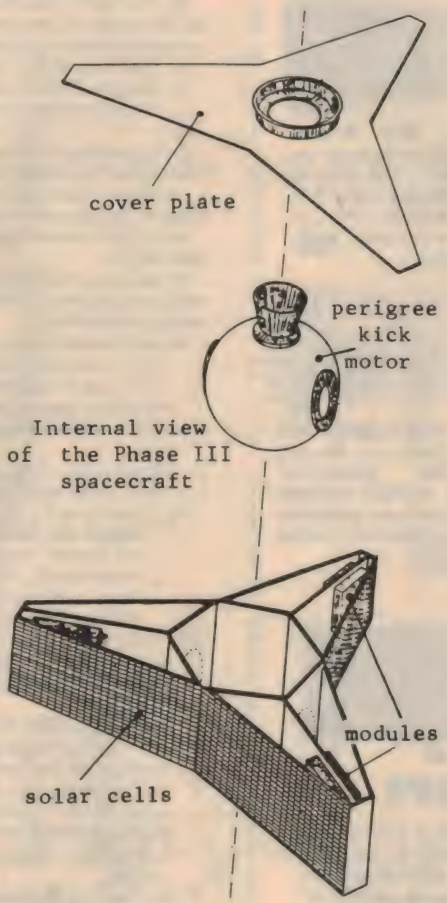
Spacecraft characteristics:
Weight: 55 kilograms. Configuration: "Tri-star" shape, each arm 0.6 metres long. Primary experiment: Two high-efficiency, high-power (50W) communication transponders. Power system: Body mounted solar arrays. Eclipse operation from NiCd battery. Propulsion system: Small perigee kick motor to modify delta orbit.

Attitude control system: Spinning spacecraft (about 120rpm); attitude will be controlled by magnetic torquing near perigee to adjust spin rate and axis orientation. Sun and earth sensors will be employed.

Miscellaneous: All onboard functions controlled by spacecraft microcomputer.

Final orbit characteristics: Apogee (h_a) = 7.1 r_e (39,000kM). Perigee (h_p) = 1.228 r_e (1460kM). Inclination (i) 101.5 deg.

The illustration shows shape and general layout of the spacecraft and other characteristics. These and the foregoing information appeared in the March 1976 issue of the AMSAT newsletter.



Design concept for OSCAR 8. The kick motor is to put it into a near geo-synchronous orbit with a slow drift.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

VK-ZL JUBILEE CONTEST

As part of the NZART Jubilee Celebrations the national amateur radio societies–NZART and the WIA invite amateurs worldwide to participate in the 1976 contest. Special jubilee awards will be made by the NZART.

Separate sections of the contest will be held on the first two weekends in October, 1976.

Details and rules are:–

Phone section: 24 hours from 1000GMT Saturday, 2nd October to 1000GMT Sunday 3rd October.

CW section: 24 hours from 1000GMT Saturday, 9th October to 1000GMT Sunday, 10th October.

RULES

1. There shall be three main sections to the contest –

   a. Transmitting phone.
   b. Transmitting CW.
   c. Receiving – "Phone and CW" combined .

2. The contest is open to all licensed transmitting stations in any part of the world. No prior entry needs be made. Mobile marine and other non-land based stations are permitted to enter. Their "country status" will be determined by the country which issued the call sign used in the contest.

3. All amateur frequency bands may be used but no crossband operation is permitted. Note: VK and ZL stations irrespective of their location do not contact each other for contest purposes except on 80 and 160 metres on which bands contacts between VK and ZL stations are encouraged.

4. Phone will be used during the first weekend and CW during the second weekend. Stations entering both sections must submit separate logs.

5. Only one contact on CW and one contact on phone per band is permitted with any one station for scoring purposes.

6. Only one licensed amateur is permitted to operate any one station under the owner's call sign. Should two or more operate any particular station, each will be considered a competitor and must submit a separate log under his own call sign. This is not applicable to overseas' competitiors operating club stations.

7. Entrants must operate within the terms of their licences.

8. Cyphers: Before points can be claimed for a contact, serial numbers must be exchanged and acknowledged. The serial number of five or six figures will be made up of the RS (phone) or RST (CW) report plus three figures which may begin with any number between 001 and 100 for the first contact and which will increase in value by one for each successive contact, e.g. – If the number chosen for the first contact is 021, then the second must be 022 followed by 023, 024, etc. After reaching 999, restart from 001.

9. Scoring: (a) For oceania stations other than VK/ZL – 2 points for each contact on a specific band with the rest of the world.

(b) For the rest of the world other than VK/ZL – 2 points for each contact on a specific band with VK/ZL stations: and 1 point for each contact on a specific band with oceania stations other than VK/ZL.

(c) For VK/ZL stations – 5 points for each contact on a specific band and in addition, for each new country worked on that band, bonus points on the following scale will be added – 1st contact, 50 points; 2nd contact, 40 points; 3rd contact, 30 points; 4th contact, 20 points; 5th contact, 10 points.

Note: (1) The ARRL countries list will be used except that each call area of "W/K", "JA", "UA" will count as "countries" for scoring purposes as indicated above.

Note: (2) Call areas include different prefixes–e.g. W1, K1, WA1, WN1 are all the same call area; just as are UA9, UK9, UV9, UW9 in same call area; or UB5, UK5, UT5, UY5 in same call area and these are not different call areas. Check this carefully – use Call Book!

(d) 80 metre section – For 80 metre contacts between VK and ZL stations, each VK/ZL call area will be considered a "scoring area" with contact points and bonus points to be counted as for DX contacts. N.B. Contacts between VK and ZL on 80 only.

AMATEUR BANDS

between VK/ZL, VK/VK, ZL/ZL and ZL/VK to the rest of the world: Each VK/ZL call area will be considered a "scoring area" with contact points and bonus points to be counted as for DX contacts (Rule 9(c)). Note: A contestant in a call area may claim points for contacts in the same call area for this 160 metre segment.

10 logs:

(A) Overseas stations: (a) Logs to show in this order – date, time in GMT, call sign of station contacted, band, serial number sent, serial number received, points claimed. Underline each new VK/ZL call area contacted. Separate log must be submitted for each band used.

(b) Summary sheet to show call sign, name and address in block letters; details of station; and, for each band – QSO points for that band; VK/ZL call areas worked on that band; "All band" score will be total QSO points multiplied by sum of VK/ZL call areas on all bands while "single band" scores will be that band QSO points multiplied by VK/ZL call areas worked on that band.

(B) VK/ZL stations: (a) Logs must show in this order – date, time in GMT, call sign of station worked, band, serial number sent, serial number received, contact points, bonus points. Use separate log for each band.

(b) Summary sheet to show – name and address in block letters, call sign, score for each band by adding contact and bonus points for that band, and "all band" score by adding the band scores together; details of station and power used; declaration that all rules and regulations have been observed.

11. The right is reserved to disqualify any entrant who, during the contest, has not strictly observed regulations or who has consistently departed from the accepted code of operating ethics.

12. The ruling of the Executive Council NZART will be final.

13. Awards–World-wide–except VK/ZL.

(a) Attractive multi-colour certificates to the top scorers in each country. (Call area in "W", "JA", "UA"). Separate Awards for phone and for CW.

(b) Depending on reasonable degree of activity, separate certificates may be awarded for top scores on different bands.

(c) Where many logs are received, consideration will be given to awarding 2nd and 3rd place certificates.

(d) NZART jubilee plaque to top scorer in each continent (both on phone and on CW).

(e) Jubilee participation certificate to every contestant forwarding a log. These will be posted direct if IRC enclosed, otherwise sent via Bureau.

VK/ZL AWARDS

Attractive multi-colour certificates–

1. To the top three scorers in each call area of VK and of ZL.
2. To the top three scorers on individual bands (160, 80, 40, 20, 15, 10) in VK and in ZL–separate awards for phone and for CW.
3. NZART jubilee plaques to top scoring VK both in phone and in CW sections.
4. NZART jubilee plaques to ZL contestants as per separate list.
5. Jubilee participation certificates to all VK/ZL entrants as per 13e above.

14. Entries from VK/ZL stations should be posted direct to–

NZART Contest Manager ZL2GX,
152 Lytton Road, Gisborne, New Zealand–to arrive not later than December 31, 1976.
From overseas stations–to the above address or NZART, Box 489, Wellington, New Zealand – to arrive not later than January 31, 1977.

SWL SECTION:

1. The rules are similar to the transmitting section but it is open to all members of any SWL society in the world. No transmitting station is permitted to enter this section.
2. The contest times and logging of stations on each band per weekend are as for the transmitting section except that the same station may be logged twice on any one band–once on phone and once on CW.
3. To count for points, the station heard must be in QSO exchanging cyphers in the VK/ZL/ Oceania DX Contest and the following details noted–date, time in GMT, call of the station heard; call of the station he is working; RS(T) of the station heard; serial number sent by the station heard; band; points claimed.
4. Scoring is on the same basis as for the transmitting section and a summary sheet should be similarly set out.
5. Overseas stations may log ONLY VK/ZL stations but VK receiving stations may log overseas stations and ZL stations, while ZL receiving stations may log overseas stations and VK stations.
6. Certificates will be awarded as listed in the section under "Awards".

SOUTH WEST ZONE CONVENTION

The 24th Annual South West Zone Convention will be held on the 2nd and 3rd October, 1976. The venue is Tumut; the "Gateway to the Snowy Mountains".

Site: Tumut Racecourse, Elm Drive, Tumut.

Early bookings essential. May be telephoned to:

Ross Weeden, VK2PN – Tumut 26, (A.H. Tumut 36) or PO Box 53, Tumut, 2720. Vince Nugent, VK2ALZ – Tumut 11 (A.H. 498). Keith Dodd, VK2ZAA – 587. (A.H.)

Make it a family weekend holiday trip to Tumut – you will be glad you did.

JAMBOREE-ON-THE-AIR

The 19th Scout Jamboree on the Air will be held over the weekend 16th-17th October, 1976.

A review of last year's event and further details in next month's notes.

Make preliminary arrangements for participation with your local scout group now.

RADIO CLUB NEWS

On Sunday, 4th July, 1976, about sixty members of the Novice Amateur Radio Group and the DX Group set up field stations on the southern and northern headlands of Sydney harbour. Some of the highlights of the activities were filmed by television stations ABC channel 2 and TCN channel 9.

During the morning an excellent relay of the VK2AWI official news broadcast was made from north head on 160 metres. The aerial was a quarter wave vertical suspended by a box kite flying 32 metres high. The input power was 10 watts, using AM. Excellent signal reports were received from around Sydney, the Blue Mountains and Newcastle.

Continuous operation was maintained between groups on the headlands on 27.125MHz and several overseas contacts were made on the 14MHz, 21MHz and 28MHz bands.

WARRNAMBOOL AMATEUR RADIO CLUB: Celebrated its first birthday on the 11th June, 1976, completing a very successful period and providing a focal point for amateurs in that area. A highlight was acting as host for the Western Zone Victorian Divison, WIA convention.

Office bearers for 1976 are; President—David Bevan, VK3AGB; Vice-president—Eric Giddings, VK3ANQ; Secretary-treasurer—Ray Smith; Technical officer—John Clark, VK3GF; Property officer—Joe Morgan; Public relations—Ian Mason.

Meeting nights are the first and third Wednesday of each month in the Buffalo Lodge rooms, Kariot Street, Warrnambool. Visitors welcome.

EASTERN AND MOUNTAIN DISTRICT RADIO CLUB: Participation in the National Library Week in September is planned by the EMDRC. The head librarian of the Nunawading Library has offered the club space for a static display plus a portable station.

The EMDRC net operates on Monday night at 8.00pm on 3.66MHz. The club station call is VK3ER. General meetings are held on the second Monday of each month in the Willis Room, Nunawading Library, Maroondah Highway, Nunawading at 8.00pm. Visitors welcome.

RADIO CLUB DIRECTORY

RADIO CLUB DIRECTORY
A REMINDER THAT 19TH OCTOBER IS THE DEADLINE FOR INCLUSION IN DECEMBER 1976 ISSUE. FOR FORMAT SEE LAST MONTH'S NOTES.

WE ALSO WISH TO PREPARE A LIST OF REPEATERS AND WOULD APPRECIATE THE FOLLOWING INFORMATION FROM REPEATER COMMITTEES. LOCATION IN LATITUDE AND LONGITUDE AND/OR PLACE NAME, CHANNEL No., ANY ACCESS INSTRUCTIONS, SPECIAL FEATURES, ETC.

ILLAWARRA AMATEUR RADIO SOCIETY: A scheduled EME test was carried out on the 5th June. The operator of VK2AMW at Dapto was Charlie Proctor, VK2ZEN, assisted by Ian Proctor.

A one hour test was made with W1JAA in Massachusetts, USA whose signals on 432MHz were 2dB to 3dB over noise.

Chart recordings have been made from a tape recording of signals received via moonbounce from WA6LET on 24th May, 1976, the purpose being to obtain data on fading characteristic of the EME path. Indications of scintillation fadings were present in addition to the very marked liberation fading pattern.

As the signal was above noise level at all times, even at the deepest part of the fades, these chart records are the most useful information obtained to date for determining what type of emission and processing of received signals could be used to obtain the greatest advantage from the characteristics of EME propagation.

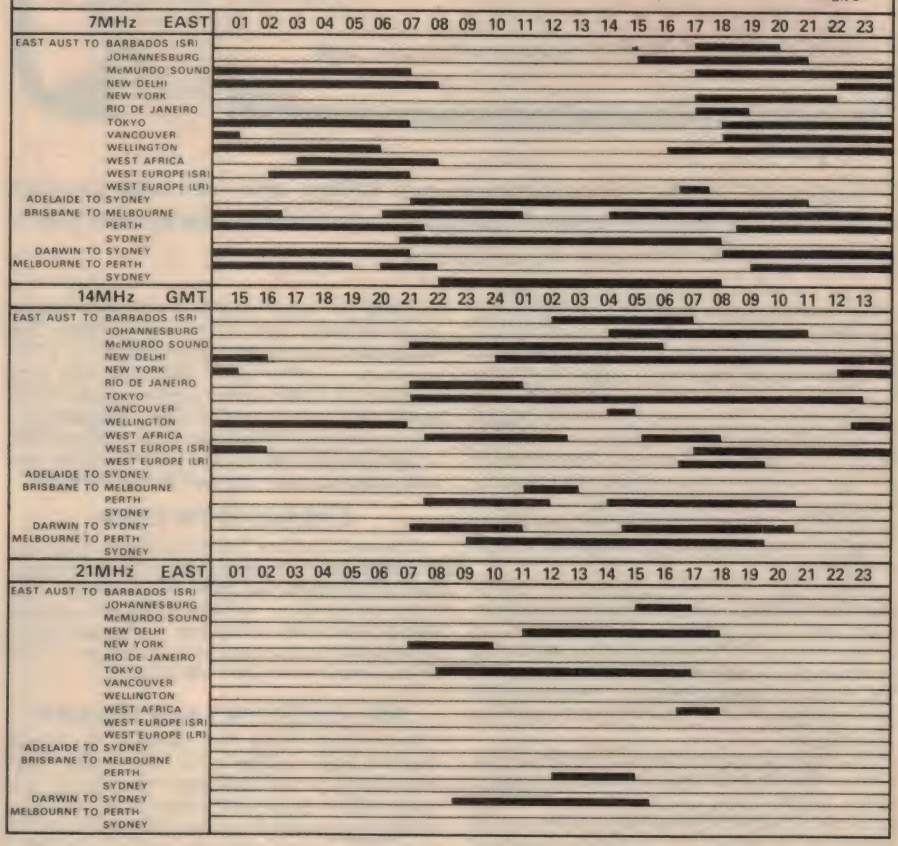
A copy of a portion of the chart has been sent to the Stanford Research Institute Group for their analysis.

General meetings of the IARS are held on the second Monday of each month at the Wollongong Town Hall Meeting Room commencing at 7.30pm.

Visitors welcome.

IONOSPHERIC PREDICTIONS FOR SEPTEMBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 9.76



ST. GEORGE AMATEUR RADIO SOCIETY: Reports have been received that the St. George repeater on channel 2 has provided excellent coverage around the Sydney area as well as reliable coverage to Port Stephens and Newcastle. Coverage to Ulladulla to the south and Oberon in the west has also been reported. The repeater was recently transferred to its permanent site at Engadine, and is said to be becoming the most popular repeater in the Sydney area.

Interesting lectures and demonstrations are a feature of the monthly meetings held by SGARS on the first Wednesday of each month at the Rockdale Civil Defence Headquarters, Highgate Street, Bexley, commencing at 7.30pm.

Visitors welcome.

GOLD COAST RADIO CLUB: Negotiations are under way to obtain a permanent venue for GCRC meetings at the old Surfers Paradise state school.

The VHF FM channel 2 repeater VK4RAG has been giving excellent service since the erection of the new antennas. Improvements to the transmitter and receiving filtering systems are currently on the drawing board. A 3dB improvement in receiver sensitivity and transmitter output power is expected.

WAGGA DISTRICT RADIO CLUB: Office bearers elected for 1976–1977 are:—President—Jeff Brille; Vice-president—John Eyles, VK2YCM; secretary—Frank Sleep, VK2CAU; treasurer—Sid Ward, VK2SW.

The new postal address of WDRC is PO Box 71, Kooringal, Wagga 2650. Meetings are held on the last Friday of each month in the Wagga Rescue Club rooms. Visitors are welcome.

The Wagga repeater, VK2RWG is providing mobile and base station coverage over most of the south west zone. Mobiles can gain access into the system over a radius of 80kM from the repeater location at Mt. Flakeney with base stations being worked over distances of 200kM.

Recently a meeting was held between members of the WDRC and the Wagga Radio-controlled Model Aero Club. The purpose of the meeting was to demonstrate the type of equipment and emissions used by amateurs. A combined club barbeque was also held at Uranquinty. Checks made showed that no interference was caused by 7MHz amateur transmissions. However, it is possible that interference could be caused by some types of transmission in the 27MHz band. The radio control frequencies in use were 26.965MHz to 27.225MHz.

MORSE CODE PRACTICE

A Morse code practice session of 30 minutes duration is conducted on 52.525MHz at 8.00pm EST on Mondays and Wednesdays by VK2GS and on Fridays by VK2BYY.

These sessions are to assist those wishing to improve their ability to receive Morse code either to the novice licence standard or higher.

Shortwave Scene

by Arthur Cushen, MBE

The present low sun spot count is still falling and has now created a record. The resulting critical reception conditions have forced short-wave stations to use lower frequencies.

Short-wave reception during 1976 has shown the greatest use of the lower frequencies with the sun spot count now at its minimum. The prediction for 1976 is 8. The low sun spot count, the lowest experienced since the 1930's when broadcasting became available, is expected to continue through this year with a possible improvement towards the end of 1977. This means that the high frequencies are no longer available for broadcasting and that many of the world's broadcasters will therefore have to use frequencies in the range 4/15 MHz for their broadcasting effort, thus considerably raising the level of interference.

According to world wide observatories on the degree of the sun spot activity, which forces stations to use lower frequencies during minimum activity and higher frequencies during maximum activity, the count over the past 11 years has been: 1964 (10), 1965 (15), 1966 (47), 1967 (94), 1968 (106), 1969 (106), 1970 (104), 1971 (67), 1972 (69), 1973 (38), 1974 (34), 1975 (17), 1976 (8).

The poor reception over the past few months due to the sun spot count being so low has been aggravated by the increasing interference to short-wave broadcasters by jamming stations and the use of higher powered transmitters. Many frequencies have been rendered useless by the present sun spot count, and interference is increasing as at the present time there are more than 600 transmitters in operation using the power of 250kW or greater. There are also many transmitters of this power under construction and due to come into operation in the next few months.

The one ray of hope for the short-wave listener is the indication from the meetings of the International Telecommunications Union at Geneva that the frequencies of the short-wave bands are to be enlarged. With better planning to avoid interference, the listener should enjoy much better short-wave reception in the very near future.

However, while the nations of the world are divided, and those in the communist area refuse to end jamming and the use of frequencies not assigned to them, some degree of chaos will continue. Many countries signed the recent agreement for the world wide interchange of ideas, but in the field of broadcasting these fine ideals have not been put into practice.

NEW MALAYSIAN OUTLET

Radio Malaysia at Kuala Lumpur has been heard on the new frequency of 9750kHz with its overseas service previously carried on 15290kHz. The transmission included an English program to 0855GMT and then followed a break in transmission. At 0900GMT an interval signal was played and then popular music, mainly English recordings, with announcements in Malay to 0930GMT. At 0930GMT, following the time signal, a news bulletin in Malay is broadcast.

Radio Malaysia in its overseas service has been operating on various frequencies in the 19 metre band, including 15275, 15290 and 15295kHz. The transmission is in English 0625-0855GMT, and has generally provided good reception. The new frequency of 9750kHz gives good reception around 0930GMT, but earlier suffers from sideband interference from HCJB (9745) and AFRTVS (9755), while at times the BBC transmission on 9750kHz has also been observed under the signal of Kuala Lumpur.

FINLAND NOW 250kW

This month, the new 250kW transmitter of the Finnish Broadcasting Company goes into regular operation. The transmitter was tested in July, and is located at Pori along with the rotatable log periodic antenna. The new transmitter will operate on frequencies between 6-26MHz. The initial tests were well received on 11755kHz with English 2100-2130GMT.

NEW FREQUENCY FOR TANAFO

Radio Tanafo in the New Hebrides, the station operated from a village in the hills of Santo, and broadcasting for the Na-Griamel Federation in now using 3990kHz. Since we first reported reception on January 20 this year the station has been observed on 7120kHz and then 3975, 3952 and now 3990kHz. According to announcements the station schedule is 1930-2030GMT and 0730-0830GMT, although the latter seems now to extend to 0900GMT.

The broadcasts continue to be in Pidgin, but according to a letter from the President, Mr Jimmy M. Stevens, the plans to add English announcements are to be implemented shortly. The power of the station is 60W.

SCHEDULE CHANGES FOR NEW GUINEA

In recent weeks it has been observed that the stations of the National Broadcasting Commission in Papua New Guinea have been closing at 1200GMT instead of the former 1300GMT, and have also advanced the sign-on time to 1900GMT from 2000GMT. Stations have been heard in the 120 and 90M bands (5am. local time) with music programs.

One of the strongest is Radio Milne Bay on 3360kHz, which opens with test music, mainly country and western recordings, around 1845GMT. The announcement at 1900GMT indicates they broadcast on 3360kHz 1900-2200GMT, and have a new mid-day transmission on 6040kHz. Other frequencies used by these NBC stations at 1900GMT include 2410, 2450, 2468, 3220, 3245, 3290, 3305, 3322, 3335, and 3385kHz

MEDIUM-WAVE NEWS

JAPAN: The Ryukyu Broadcasting Corporation from Okinawa confirms reception of JORR 740kHz with a card. The station operates 24 hours a day and has the power of 5kW. The program is repeated on 1150kHz with 500W. Our reception of JORR was at 1700GMT.

SRI LANKA: According to DX Digest of Calcutta the Sri Lanka Broadcasting Corporation has commenced testing two new transmitters. The transmitters operate on 860 and 970kHz and are located at Ampara.

AUSTRALIA: The latest Australian commercial station, 3MP Mornington Peninsula, is now in operation on 1380kHz and was first reported to us by Dick Whittington of Melbourne. Chris Martin of Sydney reporting in DX Post states that 4AK 1240kHz Okey, Qld, no longer operates 24 hours a day. This cutback has been made for economic reasons and the schedule is now 1900-1400GMT.

LATIN AMERICAN NEWS

ECUADOR: A frequency change for Radio Centinela del Sur, Loja has been heard on 4890kHz generally with sports broadcasts to closing at 0545GMT. Signals have been fair in New Zealand and have also been heard in Melbourne by Peter Bunn. Interference was noted from Port Moresby on the same frequency. The Ecuadorian station was formerly on 4752kHz.

COLOMBIA: A frequency change has been made by La Vos de los Centauros at Villavicencio, which has moved from 5962kHz to 6190kHz. The station operates 24 hours a day and has been heard around 0900GMT. Signals from this station have also been noted in Adelaide by George Kuznecovs, but reception has been spoilt somewhat by a Russian transmitter on the same frequency. In New Zealand signals are very good and stronger than the BBC relay station on 6195kHz.

GALAPAGOS ISLANDS: Some years ago we heard the Galapagos Islands on 6265kHz and our reception was the first in the Pacific area. Some years later a frequency change was made by the station and over the past few weeks this interesting island off the coast of Ecuador has been heard by many readers. The station now uses 4810kHz and has been heard opening around 1214GMT with full station announcement at 1215GMT. The program consists of bright music and signals have been observed to past 1300GMT. According to a verification received by Robert Yeo of Doncaster, Victoria, the verification stated that the present schedule is 1215-1430 and 2300-0400GMT. Local time in the Galapagos Islands is GMT minus six hours.

LISTENING BRIEFS

AFRICA

LIBERIA: VOA Monrovia is using 3990kHz for the breakfast show to Africa and is being heard around 0500GMT. The power of this frequency is only 8kW and the signal is generally better than VOA Munich on 3980kHz using the same power. The Liberia transmitter is scheduled to operate 0230-0730 and 1530-2200GMT.

BENIN: The National Radio Station at Cotonou has been observed by Melbourne listeners on 7190kHz in French from sign-on at 0600GMT to fade-out at 0730GMT. The stations signs on with a drum interval signal, the National Anthem and then an identification. Benin is the West African country which was, until a few months ago, known as Dahomey.

ASIA

IRAN: According to the BBC Monitoring Service, Radio Iran's external service transmission from 1730-1800GMT in Russian and 1800-1830GMT in Turkish are given on 15435kHz. Broadcasts from 1830-2030GMT continue to be heard on 11770kHz. The program in Pushta to Afghanistan from 1430-1530GMT is on 9680kHz.

NEPAL: According to John Campbell reporting in "Down Under" Dx Circle, Radio Nepal is operating on 7105, and 5007kHz and has English at 1420GMT. They have been also testing the 5kW transmitter at Jawalakhel on 3330kHz in an attempt to find a suitable 90 metre band frequency.

TAIWAN: The Voice of the Chinese Air Force has been noted by Des Foster of Melbourne on 6104kHz. The station was heard after radio New Zealand closed but suffered jamming at 1135GMT.

JAPAN: Nihon Shortwave Broadcasting Co now has an English DX Session on Monday 0900-0915GMT. According to Japanese listeners reporting to "Sweden Calling DX-ers", the session is carried on 3925, 6055 and 9595kHz.

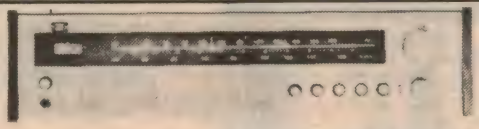
AFGHANISTAN: Radio Kabul is reported by Bill Huddleston of Auckland, NZ, as operating on 3285kHz with English news at 1400GMT. Signals in his area were poor. "Sweden Calling DX-ers" states that 4775kHz is still used at 1400-1430GMT for the English service, while 15195kHz has been heard in German at 1100GMT.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for West, 10 hours for East and 12 hours for NZT.

136 VICTORIA RD. MARRICKVILLE. NSW 2204 PHONE 51-3845

A.C.E. RADIO

12 + 12 WATTS



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Top-quality, low-cost home entertainment. Illuminated dial, brushed aluminium panel, walnut cabinet.
420 x 330 x 100mm high model DX 2400. Specs: 12 + 12 W. RMS-freq. response 30-25,000 Hz. Distortion better than 0.8%. Inputs for mag, ceramic tape, aux., bass, treble, loudness controls. FM-88-108 MHz. SEN/2.5 UV. only **$129.95** p.p. N.S.W. $7.50 reg.

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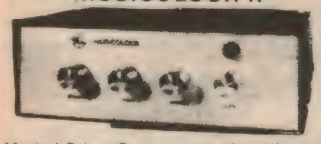
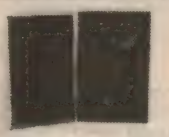


Magical Colour Organ operates in conjuction with your home stereo or PA system—simple to connect and operate. 3 channels, 1,500 watt max load per channel.

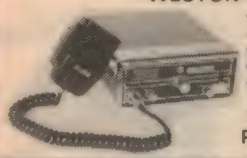
Complete kit of parts	$59.50
Constructed ready to operate	$69.50
P&P	$2.50
Interstate	$3.50

PLAYMASTER 3-45L
LOUDSPEAKER SYSTEM



Features the mighty 8-30 woofer, 6J midrange and the incomparable Philips AD016/T8 tweeter. This top quality low cost 3 way hifi system is available from stock in either walnut or teak veneer and complies with the specs as per April '75. **$84.00** ea.

WESTON 5 WATT C-B TRANSCEIVER



Great boat or mobile rig. Auto noise limiter, squelch, A.G.C. over mod. limiter. Low pass filter for bandwidth. SPECS: T-mitter: Crystal locked, 5 watts input to RF stage. Freq. coverage: Any 11 channels in 27 MHz band. Receiver: crystal locked, double superhet, 6.5 MC and 455 Kc. 1fs 3" speaker, dynamic mic, 50 ohm antenna. 20 transistors, 8 diodes. 12VDC operation. Sensitivity: 0.5UV 10dB S/N. Size 6½" x 2½" x 7¾". Wt. 4½ lbs.

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KENWOOD TRIO OR 666 COMMUNICATION RECEIVER

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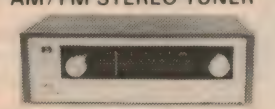
Type A Penlight **$1.85** ea. 4 for **$6.90**.
Type C **$3.20** ea. 4 for **$11.50**.
Type D **$3.65** ea. 2 for **$6.80**.
P.P. N.S.W. $1.00 other states $1.75.

AM/FM STEREO TUNER



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p.p. N.S.W. $3.50. Interstate $4.50.

BLACK ALUMINIUM KNOBS

20 dia x 17 mm. Chrome marker.
6 for **$2.50** p.p. 75c

5500KHZ CRYSTAL. FT-243 HOLDER

$5.50 p.p. 50c

KAISE SK-44 MULTI-TESTER

30,000 OPV DC 8 ranges D C V 0.6 — 3KV. 5 ranges ACV. 6 — 1200. DC current 30UA, 6, 60, 600 MA ohms. 10K, 1M, 10M. 100M. — 20 +17, 31, 43, 61, 63dB. Double jewelled meter.

With mirror scale, D10.E protected. Circuit. **$27.50** p.p. $1.50

E-TONE 60 WATTS RMS LOUDSPEAKER

30cm (12") 8 and 15 ohms VC dia. 5.1cm Big 3KG magnet. Freq. 40-7000 Hz for bass guitar. Organ. Guitar weight 4.5 Kg. **$45.00** p.p. $3.50
Send S.A.E. for price & data of other models incl. 38 CM 100W.

7 WATT SPEAKER SYSTEM

An ideal extension speaker for the rumpus room—attractive enough for the lounge room. Frequency response of the 6" twin cone 80HM speaker is, 75-15000Hz. Teak vinyl covered cabinet 15" x 10" x 7". Black grille cloth. **$16.95** ea.

RED ROTATING DISTRESS BEACON

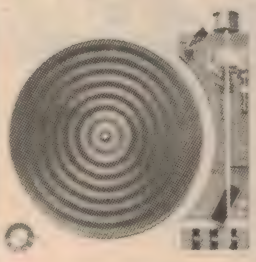
For car, truck or boat; fits with heavy duty suction sap. 12 volt 2 amp **$9.95**. p.p. NSW $1.50 Interstate $2.50

PLAYMASTER 25 + 25 STEREO AMPLIFIER

Complete kit of top quality parts **$89.00**. Fully constructed **$118.00**. P.P. N.S.W. $3.50. interstate $4.50

Chassis and cover only **$16.95** p.p. $3.50. Brushed aluminium front label **$7.30** p.p. $1.20
Printed circuit board **$4.95** P & P $1.00

GARRARD MODEL 82



$57.00.

A superb 3 speed transcription changer/player. Auto/manual operation 4 pole magnetically shielded syn. motor. Resiliently mounted. Counterbalanced. Elegant tone arm with slide-in cartridge carrier calibrated. Antiskate. 265mm (10½"). Aluminium platter. Cue and pause control. Cartridge tilting lever. Magnetic cartridge diamond stylus. Size 375 x 335 x 170mm (14¾" x 13¼" x 6¼") 4.5kg (10 lbs) P'& P $2.50 Interstate $3.50.
Also available is the deluxe changer/player **SL95B**. Has all the above features plus the world-famous synch-RP LAB motor, a tone arm of advanced design. A new record release mechanism, also a heavyweight non magnetic platter. With magnetic cartridge, diamond stylus. Each model is supplied with comprehensive instruction manual. Super price $65.00 P & P $2.50. Interstate $3.50. Mounting base and perspex dust cover for either model **$28.50**. Send S.A.E. for more details.

GARRARD CHANGER/PLAYERS

MODEL—6400 3 speed auto manual changer—player 2 spindles. Motor 2 pole 240V 50Hz 10½" turntable cue and pause, tubular section pick up arm, Sonatone cartridge, diamond stylus. Great value **$28.50**.
MODEL—62 3 speed auto or manual operation, 250V 4 pole motor. Magnetic cartridge, diamond stylus, main features, 10½". T Table. Counterweight. Cue and pause control. Stylus force indicator, Bias compensator, Slide in cartridge. Carrier Size 13¼" x 11¾. 4½ above, 2¼ below board. **$39.95**

p.p. Reg NSW. $3.60, Q, V, S.A. $4.75, T. $5.50, WA $6.75.
Pre-cut base $14.50. Perspex cover $14.00 add p.p.

NEW MODEL MAGNAVOX SPEAKERS

10-40 10" base 15 and 8 ohms **$20.95**. 625 6" mid range 8 ohms **$14.95**. XJ3 dome tweeter **$7.80**. Famous 8-30 8 ohms **$14.95**. Magnavox 3 way cross-over for 10-40, 625 and 2 XJ3 **$19.50**. P & P N.S.W. $1.40. Interstate $2.20.

HI FI CABINET KITS

Do it yourself—big savings. Our kits are extra easy to finish. Top, bottom, each side and back are factory assembled, baffle is pre-cut. Veneered pyneboard. Teak or walnut. Complete with innerbond and speaker grille cloth. 8-30. 3-45L, 3-41L systems. **$48.00** pair.
MV-50 system **$65.00** pair.

LM 377N

2 WATT AUDIO 1-C
$1.50 P.P. 40c

FOLDED LINE REVERBERATION DEVICE

By O.C. Electronics Inc.
$19.95 p.p. $1.00

AC ADAPTOR BATTERY SAVER

For 6, 7½, 9V 300 MA gear powers battery operated calculators, portable radios, cassette recorders, etc. off 240V AC.

$7.50 p.p. 75c

E.M.I. 5 OSCILLOSCOPE

In rugged metal cabinet, for bench or 19" rack mounting. Mullard DG-13-2 CRO tube plus 11 valves, controls—vert. and hor. shift, vert. and hor. gain, focus, brightness, vert. and hor. inputs, operates off 240V 50HZ. N.B. Requires ext. time base. **$27.50**. Freight extra.

TV CHANNEL GENERATOR

Requires 36 MHZ. If input converts to standard channel frequencies. 240V 50 HZ operation. Bench or 19" rack mounting. **$17.50** Plus freight.

WE REGRET THAT PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE.

MAGNAVOX WIDE RANGE TWIN-CONE SPEAKERS

8-16 OHMS	30-16,000Hz
6WR MK5 12W RMS	$9.90
8WR MK5 16W RMS	$10.75
10WR MK5 16W RMS	$12.65
12WR MK5 16W RMS	$14.95

p.p. NSW 95c, Interstate $1.50

POTENTIOMETERS

¼" shaft. Brand new. 2 Meg C. 250KC. 250KA. 150KA. 100KA. 100KC 25KA. 5 for **$1.50** p. p. 65c
2 megC. Ganged, 2 Meg A. Ganged. 50KA. Ganged, 25KC. Ganged.
250KC + 250KA. With switch, dual concentric, 10KC. With SW. dual. 5 for **$2.50** p. p. 75c

NEW VALVES

152	$1.15	6EH7	$1.20
1B3	1.65	6EJ7	1.20
5AS4	1.80	6EM5	1.55
6AL3	1.15	6ES8	1.65
6AU4	1.85	6GV8	1.50
6BL8	1.10	6GW8	1.50
6BM8	1.10	6HS8	2.00
6BQ5	1.45	6U8	1.50
6BX6	1.60	6U9	2.00
6CA7	3.60	6V9	2.00
6CG7	1.65	6X9	2.00
6CM5	1.65	6Y9	2.25
6CW5	1.35	12AU7	1.50
6DQ6	2.50	12AX7	1.50
6DX8	1.40	P-P	1.00

NEW VALVES—TO CLEAR.

75 CENTS EACH

6AJ8, 6AX5, 6BX7, 6BQ7, 6AN8A, 6BW7, 6CQ6, 6CM6, 6HG5, 6AD8, 6BH5, 50EH5, 15A6, 16A5, 21A6, •15CW5, 12AV7, 652, 8LT8, 6062, 75C1, 5686, 5842, 5963, 6386, 6485, 7551. p.p. $1.00.

BC221 FREQUENCY METERS

Brand new in original packing cases—unopened complete with 240 volt power supply. Charts, etc. $90 each—cartage to rail $1. Freight payable at nearest attended railway station.

P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$35.00
(2 TELEPHONE SETS)

$1 cartage to rail. Freight payable at nearest attended railway station.

TEN CHANNELS VHF TRANSCEIVER

TR1956 125-150 MHz. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator.

$33.00

TUNING UNITS

T.U. Series. Contains variable condenser suitable for aerial tuning, vernier, etc. 19" rack mounting. only $9.50 EA. Post A $2.30, B $3.75, C $4.80, D $6.55.

FREQUENCY METERS

AN URM 32 A 120 KHz to 1000 MHz, with 240V power supply, $125
$1.00 cartage to rail, freight payable at nearest attended railway station.

ILFORD 17.5 mm SPROCKETED MAGNETIC TAPE

1000 ft reels brand new original packing **$4.00 ea.** quantity available

Post A $1.30, B $2.00, C $2.30, D $2.80

No. 62 TRANSCEIVER

With headphones, accessories etc.

$60

TELEPHONE WIRE

1 mile twin (2 miles) genuine ex-Army. Don 8 perfect condition $35 per drum. $1 cartage to rail freight payable at destination.

PRISMATIC COMPASSES

Genuine ex-army Mk 3, liquid damped, as new $45.00 P & P A. $1.70, B. $2.25, C. $2.40, D. $2.65.

MORSE KEY $1.40 Post 40c

MORSE KEY BUZZERS $4.25 Post 60c.

DYNAMIC TRANSISTOR CHECKER

Provides a visual indication of signal output. Tests: electrode open circuits, short circuits, current gain. **$14.95 ea.**
P & P A $1.70, B $2.25, C $2.40, D $2.65

MULTIMETER

A compact and handy tester for workshop or lab where quick circuit checks are required.
DC Voltage 5-2.5K (20,000 OHMS per volt) AC Voltage 10-1000V (10,000OHMS per volt) DC Current 0-50 UA, 0-2.5 MA, 0-250 MA. Resistance 0-6 Megohms Decibels — 20 to plus 22 DB. Complete with instructions.

Only $17.25 ea. Post $1.05
30,000 ohm per volt. **$23.75** P & P $1.05

ADLER FREQUENCY METER

100KHz 20MHz **$95**

4 DIGIT RELAY COUNTERS

50 volt DC, suit slot car Lap counters, etc.

$1.25 each. P & P 60c

NIBBLING TOOL

Cuts sheet metal like a punch and die, trims, notches and cuts to any size or shape over 7/16inch.

ONLY **$9.95**
Post $1.10

NIFE CELLS

1.2 Volt, fully charged, 4in x 3in x 1in 4 AH.

$1.50 each. P & P 60c.

MUIRHEAD

Decadade oscillator. Type DG 38A
$100.00

HANDY SIGNAL INJECTOR

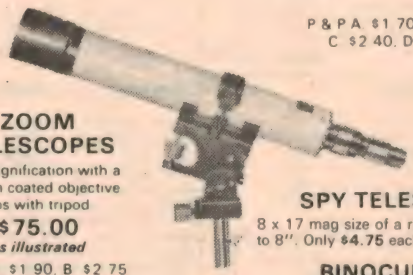
Produces an Audio Signal in rich harmonics. Ideal for Sig Tracing in A.F., I.F., and R.F. circuits. Powered by 4 Penlight Batteries with On-Off Switch and indicator lamp. Size 1½" Diam. 5" Long. Only

$6.50. Post $1.10

TELESCOPES

25 x 30 $6.50

P & P A. $1.70, B. $2.25, C. $2.40 D. $2.65



ZOOM TELESCOPES

60 magnification with a 60mm coated objective lens with tripod

$75.00
as illustrated

P & P A. $1.90, B. $2.75, C. $3.20, D. $3.95

WALKIE TALKIES 2-WAY RADIO, PMG APPROVED

1 watt, 11 transistor **$130.00** set of 2.

P & P A. $1.80, B. $2.50, C. $2.80, D. $3.20

SMALL COMPUTER PANELS

3in x 2in containing 2 valves, qty. of resistors, etc.

ONLY 75c. P & P 60c

ELECTRONIC FREQUENCY COUNTER

Austronic type DFC-4 240V 50 cycle 0-100KHz **$150**

IMPELLER PUMPS

New gunmetal body, Stainless Steel Shaft, Neoprene Impeller. Up to 15ft. Lift, suitable for almost any type of liquid. Self priming. Ideal boat bilge pump, sullage drains, etc. Approx size 8" x 5"

⅜" **$23.30**

½" **$31.95**

P & P A. $1.90, B. $2.75, C. $3.20, D. $3.95

RECEIVER No. 210

2-16 M/cs **$65.**
Transmitter No. 11 suits 210 **$35.**
24 volt Power supply to suit above **$15.**
Or complete station with Headphones, Mic, Morse Key, Antenna **$110.**

SIGNAL GENERATOR

Palec Model SG1 150 Kc/s to 30 M/cs
240 VAC **$37.50.**
$1.00 cartage to rail.
Freight payable at nearest attended railway station

522 Transceivers 100 150M CS

$35.00

5" CRO TUBE

5 BPI **$5.50** each.
Post A. $1.40, B. $2.25, C. $2.70, D. $3.45

POSTAGE KEY:

A: NSW.
B: Vic, Qld.
C: SA, NT, Tas, New Guinea,
D: WA.

VALVES

BRAND NEW IN CARTONS

6SN7GT	95c	CV850	$1.50
5U4G	95c	1H6G	75c
EF50	75c	832	$5.00
5Y3	$2.25	6X4	$2.25
2 x 2	75c	VR64	75c

P & P 40c

AIRCRAFT CLOCKS

Genuine eight day jewelled movement sweep second hand. Dash mounting. $29.50 EA. P. & P. $1.10.

CONDENSER LENS

1½" Diam 4½" F.L. 75c 2½" Diam 2" F.L. $1.50 each. Or $2.50 per pair. P & P 40c

TELESCOPES ZOOM FOCUSING

30 x 30 $23.95 — 45 x 40 $36.50

P & P A. $1.70, B. $2.25, C. $2.40, D. $2.65

SPY TELESCOPES

8 x 17 mag size of a rifle cartridge extends to 8". Only $4.75 each, post 60c.

BINOCULARS

PRISMATIC Coated Lenses. Brand new. Complete with case.

7 x 35 Wide Angle	$35.50
8 x 40 Wide Angle	$39.50
7 x 50	$31.50
10 x 50	$32.50
12 x 50	$33.65
20 x 50	$37.95

P & P A. $1.80, B. $2.50, C. $2.20, D. $3.20

SOLENOIDS

Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio, etc.

$2.50 P & P 20c

200 MA 24 volt, ⅛in push movement.
$2.50 P & P 20c.

SELSYN MOTORS MAGSLIP

MK 11 **$5.25 ea.**

3000 TYPE RELAYS

P.M.G. 200Ohms — 1'500Ohm Coils $2.50 each P & P 60c.

P.M.G. TYPE KEY SWITCHES.
45c P & P 20c

Cintel Oscillator and Electronic Counter, type 388.

$250

SPECIAL lucky dip valve offer, 15 new valves in cartons for only $2.95. We haven't got time to sort them, so you reap the benefit.
P & P A. $1.80, B. $2.50, C. $2.80, D.

RADAR TRANSCEIVER

X BAND WITH KLYSTRON ETC. **$45.00**

PANORAMIC ADAPTOR

E.M.I. type PRA-1 455 variable Kc
Course 440-520 Kc
Centre Freq 520-440 Kc
Fine Centre Freq 20-0-20
Filter band with 50, 100, 200 L.F.
200 H.F. Sweep band width 0-200.

$75.00.

TRANSCEIVERS Ex Army

No C42 set. 36 to 60 MHz complete with 24V power supply, headphone, mic, leads etc **$65.00.**

No C45 set. 23 to 38 MHz complete with mast, headphones, mic, 24V power supply etc. **$95.00.**

$1.00 cartage to rail, freight payable at nearest railway station.

Hartley double beam oscilloscope. Type 13A with probes.
Working **$150.00**

77D x RCA STUDIO RIBBON MICROPHONES Variable pattern & response music or speech $80.00 ea. Post A $3.30 B $4.00 C $4.30 D $4.80.

EX-ARMY TWO-WAY FM RADIOS

1.2 WATTS OUTPUT
SUPERHET
PRC9 AND 9A 27 to 39 M/HZ
PRC10 AND 10A 38 to 55 M/HZ
COMPLETE WITH HANDSET
ANTENNA AND BATTERY
ONLY **$25** EA
P&P A$2, B$4.50, C$4.50, D$6.35

16MM SOUND PROJECTORS IN GOOD WORKING ORDER

240 volts operated. Complete with Speaker and Amplifier.

CINEVOX **$150.00**
BELL & HOWELL **$250.00**
SIEMENS **$375.00**

$1 Cartage to Rail. Freight payable at nearest attended Railway Station.

MICROPHONES OMNI DIRECTIONAL 50K OHMS

FREQ. RESPONSE 100-10,000Hz
Sensitivity 56dB complete with 5ft cable. Microphone Holder and Stand Base only $7.95 ea.
P&P A$1.70, B$2.25, C$2.40, D$2.65.

REPERFORATOR

Genuine Siemens Type 33c **$65.00**

Deitch Bros.

70 OXFORD STREET, SYDNEY 2010

SORRY NO C.O.D.

INFORMATION CENTRE

SYNTHESISER: The idea in the May 1976 "Circuit and Design Ideas" for producing chords on a synthesiser is barely within my comprehension, and I wouldn't know how to start using such an idea in practice. But the idea is of immense interest, and a practical unit would surely be applicable in a number of keyboards areas. Would it be possible to design a practical unit as an EA project? I am sure the response would make it really worthwhile. (R.B.M., Ashburton, Vic.)

• Such a project would take a fair amount of development, R.B.M., and may also have limited appeal. But we'll certainly give the idea some thought.

TRANSISTOR ASSISTED IGNITION: I decided to make this system as described in your August 1975 issue (File No 3/TI/13). I have had no luck in getting it to operate and have had qualified persons to check the wiring, etc, of the unit so I am wondering if you will be able to assist me in the matter. All parts are as listed. The circuit is so simple maybe the transistors are of the wrong type or something of that nature. Could you advise me the best way to find the trouble? (L.S., Greymouth, NZ.)

• Unfortunately, you have supplied no information as to the fault symptoms. In order to help us help you, we suggest you fit the system temporarily to your vehicle and take voltage readings around the circuit with the points open and then closed. Send the voltage readings, along with the usual Information Service fee of $2 and we should be able to pinpoint the fault.

CDI: I installed your CDI system, described in the August 1970 issue (File No 3/TI/6), on a 6-cylinder Torana and have been very pleased with the way it has performed. However I have now changed to a Suzuki LJ50 (4WD) which has a 3-cylinder two-stroke engine. Can you tell if it is possible to put the CDI on the Suzuki without causing any damage? I have written to Ateco-Suzuki and they said it would be possible to put the CDI on. But I have to be careful because Suzukis have a reputation for burning holes in the pistons if the wrong brand of plug is used. I'm a bit concerned that CDI would make the plugs burn hotter. Your help would be greatly appreciated. (M.V.E., Lithgow, NSW.)

• First we must give a warning that the installation of a CDI system on a new vehicle may possibly void the warranty. Your claim that the Suzuki is critical of plugs also gives us some pause and it may be better, for your own peace of mind, not to install the CDI system. However, as a general remark, we cannot foresee any particular problems with CDI installations on two-stroke engines.

PLAYMASTER TWIN 25: I recently purchased a kit for the Playmaster Twin 25 from Dick Smith Electronics Pty Ltd. I was bitterly disappointed in the performance when finally assembled and after a lot of work, I found the trouble to be in the BC319 transistors as substituted by the above firm. All were very low gain and not compatible with BC109 transistors. I am writing this letter as it may help someone who has come across this problem. (W.J., Gilles Plains, SA).

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Dyeline transparencies, actual size but of limited contrast: $2. Specify positive or negative. We do not sell PC boards.

REPLIES BY POST: Limited to advice concerning projects published within the past 2 years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Only as available. Within last 6 months, face value. 7-12 months, add 5c surcharge; 13 months or older, add 10c surcharge. Post and packing for 60c per issue extra.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee, for reply in the magazine, at the discretion of the Editor.

COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia".

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

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ESCRAFT

	Price
Neosid Balun 75/300 uncased	$0.65
O.S.A.B. Outside aerial balun (water proof)	3.81
6.SB 6ft. Balun Fly Lead	3.65
P.S.B. Plug and Terminal Balun	2.53
2.75.T/S 2-way 75 ohm Transformer Splitter box	6.74
3.75.T/S 3-way 75 ohm Transformer Splitter box	8.41
4.75.T/S 4-way 75 ohm Transformer Splitter box	8.94
5.75.T/S 5-way 75ohm Transformer Splitter box	12.66
2.3T 2-way 300 ohm Splitter box	4.48
3.3T 2-way 300 ohm Splitter box	5.86
4.3T 2-way 300 ohm Splitter box	7.12
Adjustable Low Band Attenuator	6.31
10" diameter degaussing coil	24.00

TELEVISION AERIALS FOR COLOUR

CHANNELMASTER

9el Colour Crossfire 3615A	$38.34
13el Colour Crossfire 3614A	43.91
17el Colour Crossfire 3613A	57.45
21el Colour Crossfire 3612A	66.64
24el Colour Crossfire 3617A	70.87
28el Super Crossfire 3617A	106.79
Super Coloray the 3111 Ghost Killing Aerial	36.50
2el Small Coloray 3110	22.75

HILLS E.F.C. RANGE 75 ohm

E.F.C. 1	$24.17
E.F.C. 2	32.06
E.F.C. 3/24	46.65
E.F.C. 4/24	58.69

HILLS THE NEW TELRAY RANGE—

All Australia V.H.F. Channels & F.M.

6el	TL1	$19.52
8el	TL2	26.84
9el	TL3	32.70
11el	TL4	39.70

HILLS AERIALS

2010	Airways	$42.50
CA16	Phased Array	33.16
Extra Gain Lift els for CA16		3.33
8el	215	19.26

AUSTENNA STARFIRE RANGE

7EL	CC7FA	$26.39
9EL	CC9FA	31.18
13EL	CC14FA	57.00
18EL	CC19FA	62.17

FM AERIALS

Hills	2EL FM1	$8.17
HILLS	3EL 353	11.16
Hills	3EL FM3	1754
HI-Q	4EL	17.05
HI-Q	Gutter clip	11.55
Matchmaster	G2FM	17.54
Austenna	FM3F	19.96

COAXIAL CABLES

	Attenuation per 100ft at 200MHz	Reel Size	Price
Belden 9242 Double screened with	4.0 dB	500 ft	$42.28
Belden 9248 Duofoil and Braid Aluminium	3.1 dB	500 ft	58.61
TVM1A Concordia Copper Screened	4.4 dB	100 metre	30.15
Hartland WH89 Copper Braid	3.3 dB	100 metre	36.92
Hartland WH87 Copper Braid	6.0 dB	100 metre	26.65
Hartland WH86 Copper Braid	6.5 dB	100 metre	19.25
300 ohm Feeder Cable	1.8 dB	100 metre	8.80
Open wire line 300 ohm	1.5 dB	100 ft	9.90
Open wire line 300 ohm	1.5 dB	300 ft	29.80

LAB GEAR AMPLIFIERS

VHF

	Price
Mast head 22 dB 75 ohm	$72.43
CM 6014/DA 20 dB	60.25
CM 6034/DA 4 outlets 8 dB each	54.90
CM 6036/DA VHF 30dB UHF 28dB	84.63
Televerta (VHF to UHF frequency converter)	67.48

KINGRAY AMPLIFIERS

	Price
D15/500 m/V	$48.80
D30/500 m/V	57.95
D40/600 m/V	79.30
D12/1500 m/V	67.10
MH 20 mast Head 300-75 ohm	64.63

TELESCOPIC MASTS

20ft	18g steel in 10ft sections must be guyed	$19.30
30ft		$30.81
40ft		42.00
50ft		54.42

Stolle Aerial Rotator with Thrust Bearing for heavier rigs $101.43

ALL TYPES OF HARDWARE IN STOCK
Wall Brackets, Chimney Mounts, J Brackets, Guy Rings & Guy Wire. Masts from 8ft to 50ft.

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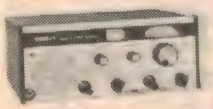

Drake General Coverage Receiver
.5mHz to 30mHz Battery & Mains

$299.00 Plus P&P.

BARLOW-WADLEY RECEIVERS

Model XCR-30 Mk II 500kHz to 31 MHz continuous coverage, crystal controlled reception of AM/USB/LSB/CW.

$235.00

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7 TRANSISTOR RADIO KIT
Silicon transistors, complete with instruction book, carrying case and earphones.
Special price $5.95.

10 TRANSISTOR RADIO KIT
With RF stage $9.95.
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INFORMATION CENTRE

• BC319 transistors can be substituted for BC549, or 109 but, as we noted in the June article on the amplifier, there is a tendency to "motorboat" when the volume control is at zero setting. This is due to a very high frequency oscillation in T3 and T103, and is cured by fitting a ferrite bead, type FX1115, to the base leads of T3 and T103. The leads of these two transistors should be first sleeved to prevent noise being generated when the bead touches base and either collector or emitter.

It seems likely that the reason for the trouble you had with the BC319s was that they were inserted with collector and emitter leads transposed. In this condition the transistors work but they have very low gain. Note: BC319s have a different lead-out from most BC549s currently on the market.

PLAYMASTER 142 IC AMPLIFIER: Recently I built the Playmaster 142 kit, and I was pleased with the operation of the amplifier for two weeks. But I switched the amplifier on one day to play a few records and there was a loud bang from inside the cabinet. A general inspection inside disclosed that the 10 ohm resistor connected between the input earth and pin 3 of the left channel IC had exploded.

I replaced this resistor, and after carefully checking for shorts I tried it again. Once more, the resistor exploded, but after checking the board once more, and replacing the resistor, it did not explode! Since then a few more explosions and a couple of integrated circuits later it has me stumped. Would you be able to give any ideas as to why this is happening, and possibly a remedy? Congratulations on a fine magazine. (M. H., Holden Hill, S.A.)

• Investigations in our lab on a representative 10 ohm ½W resistor have disclosed that with 27V applied (the maximum likely to occur due to a fault in the printed board or power supply wiring) the resistor merely catches fire, and does not explode. It is our feeling that to explode the resistor, it would require a voltage of 240V, ie, the mains.

This leads us to believe that the cause of your trouble is a faulty input device. If 240V AC was applied to the earth connection of either input, then a large current would attempt to pass through both 10 ohm resistors (which are essentially in parallel), and through the internal connection between pins 3 and 14 of the ICs. This would almost certainly result in the destruction of one or more of the resistors, and might also damage the ICs themselves.

We suggest that you check carefully that all input devices to the amplifier are wired correctly, and in particular that there are no inadvertent connections between the mains wiring and the input earths of the amplifier. Any fault detected should be corrected immediately, as it may prove dangerous otherwise. As a precaution, check the mains wiring of the amplifier as well.

DIMMER: Regarding the Varilight Dimmer circuit (Projects & Circuits Handbook): will the Triac handle a 1kW load if the SC141D is well heatsink and/or replaced with well heatsink SC151D.

If the Musicolour (Projects & Circuits Handbook) was supplied with continuous tones at (for example) 250Hz for the low channel, 1kHz for the medium channel and 3kHz for the high channel and a 15 amp 240VAC supply was available, would it be possible to use the unit as a three channel dimmer with a rating of 1kW/channel?

Do you know where a 1N3716 tunnel diode can be obtained? Also can an AA119 diode be used to replace an 1N82 FM detector diode? If not, do you know of anyone who stocks an 1N82 diode?

I must congratulate you on a great magazine. It is certainly worth more than $1.00 charge. (P.F., New Lambton, NSW.)

• The Varilight can handle an incandescent lamp load of up to 1kW if the heatsink is at least 50 mm square of 20 gauge aluminium. The individual lamps should not be rated in excess of 150 watts.

The Musicolour could not be used as dimmer in your suggested mode because the continuous tones cause a "beat" effect which varies the lamp brilliance periodically.

NOTES & ERRATA

MINISPOT 455kHz OSCILLATOR (File No. 7/RO/45): The printed board pattern designated 72/g/7 in the text and parts list should be designated as 70/g/7.

1976 AUTODIM (January 1976, File No. 2/PC/21): In order to achieve correct operation in the automatic modes, it is necessary to ensure that the 2500uF electrolytic timing capacitor is fully formed. To do this, remove the capacitor from circuit, and apply its rated DC voltage through a 1k resistor for about ten minutes. Then reconnect it to the circuit, and check for correct operation.

LED LEVEL METER (June 1976, File No. 1/MS/14): It has been brought to our attention that the 1uF tantalum capacitors specified at the inputs are unsuitable for this role. These three capacitors should be replaced by 1uF polyester capacitors. For amplifiers rated at up to 200 watts, use capacitors with 100V ratings, and use 400V types for higher powered amplifiers.

650MHz PRESCALER (August 1976, File No. 7/F/20): In the parts list on page 53, and in the circuit diagram on page 54, a transformer type PF2115 was specified. This number is incorrect and should be PF2155.

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